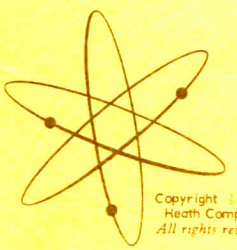
PRICE $2.00

# HEATHKIT®
# ASSEMBLY MANUAL



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## AUDIO GENERATOR
### MODEL IG-72

595-562-02

Dear Customer:

You have just purchased one of the best performing electronic products in the world — your Heathkit.

Here's how we aim to keep it that way:

## Your Heathkit Warranty

During your first 90 days of ownership, any parts which we find are defective, either in materials or workmanship, will be replaced or repaired free of charge. And we'll pay shipping charges to get those parts to you — anywhere in the world.

If we determine a defective part has caused your Heathkit to need other repair, through no fault of yours, we will service it free — at the factory, at any retail Heathkit Electronic Center, or through any of our authorized overseas distributors.

This protection is exclusively yours as the original purchaser. Naturally, it doesn't cover damage by use of acid-core solder, incorrect assembly, misuse, fire, flood or acts of God. But, it does insure the performance of your Heathkit anywhere in the world — for most any other reason.

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What happens after warranty? We won't let you down. If your Heathkit needs repairs or you need a part, just write or call the factory, your nearest retail Heathkit Electronic Center, or any Heath authorized overseas distributor. We maintain an inventory of replacement parts for each Heathkit model at most locations — even for models that no longer appear in our current product line-up. Repair service and technical consultation is available through all locations.

We hope you'll never need our repair or replacement services, but it's nice to know you're protected anyway — and that cheerful help is nearby.

Sincerely,

HEATH COMPANY
Benton Harbor, Michigan 49022

Assembly
and
Operation
of the

HEATHKIT

# AUDIO GENERATOR

## MODEL IG-72

TABLE OF CONTENTS


Introduction. . . . . 2

Construction Notes. . . . . 2

Parts List. . . . . 3

Proper Soldering Techniques. . . . . 5

Step-By-Step Procedure. . . . . 7

Step-By-Step Assembly -

- Parts Mounting - Chassis . . . . . 8
- Parts Mounting - Front Panel . . . . . 10
- Switch Wiring. . . . . 12
- Transformer Wiring . . . . . 16
- Alternate Line Voltage Wiring . . . . . 16
- Wiring-Chassis Bottom . . . . . 17
- Wiring-Chassis Top . . . . . 20

Initial Test And Adjustment. . . . . 22

Final Assembly. . . . . 24

Operation. . . . . 25

In Case Of Difficulty. . . . . 26

Factory Repair Service . . . . . 27

Specifications. . . . . 29

Circuit Description. . . . . 30

Schematic. . . . (fold-out from page). . . . . 31

Replacement Parts Price List
(fold-out from page). . . . . 32



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BENTON HARBOR, MICHIGAN 49022

# INTRODUCTION

The Heathkit Model IG-72 Audio Generator, which is designed for laboratory use, provides nearly perfect sine wave signals with metered output level. This Audio Generator can be used as a signal source for bridge and harmonic distortion measurements, as an external modulator for an RF signal generator, and in testing audio amplifiers for gain and frequency response.

Accurate, repeatable frequency selection is accomplished by the use of three switches. These switches select the first two significant figures and multiplier of frequencies between 10 cps and 100 kc.

The Generator can provide output signals into a high impedance load (10,000 Ω and higher) with full scale (F.S.) ranges of .003 to 10 volts. Many uses require a signal source with 600 Ω (industry standard) impedance. Such signals are available from the Generator with full scale ranges of .003 to 1 volt.

Simplicity in design results in economy without loss of performance, and it also provides a satisfying assembly experience. Careful assembly will result in stable performance and a long useful life of the Generator.

# CONSTRUCTION NOTES

This manual is supplied to assist you in every way to complete your kit with the least possible chance for error. The arrangement shown is the result of extensive experimentation and trial. If followed carefully, the result will be highly stable and dependable performance. We suggest that you retain the manual in your files for future reference, both in the use of the equipment and for its maintenance.

UNPACK THE KIT CAREFULLY AND CHECK EACH PART AGAINST THE PARTS LIST. In so doing, you will become acquainted with the parts. Refer to the information on the inside covers of the manual to help you identify the components. If some shortage or parts damage is found in checking the Parts List, please read the Replacements section and supply the information called for therein.

Resistors generally have a tolerance rating of 10% unless otherwise stated in the Parts List. Tolerances on capacitors are generally even greater. Limits of +100% and -20% are common for electrolytic capacitors.

We suggest that you do the following before work is started:

1. Lay out all parts so that they are readily available.
2. Provide yourself with good quality tools. Basic tool requirements consist of a screwdriver with a 1/4" blade; a small screwdriver with a 1/8" blade; long-nose pliers; wire cutters, preferably separate diagonal cutters; a penknife or a tool for stripping insulation from wires; and a soldering iron (or gun). A set of nut drivers, while not necessary, will aid extensively in construction of the kit.

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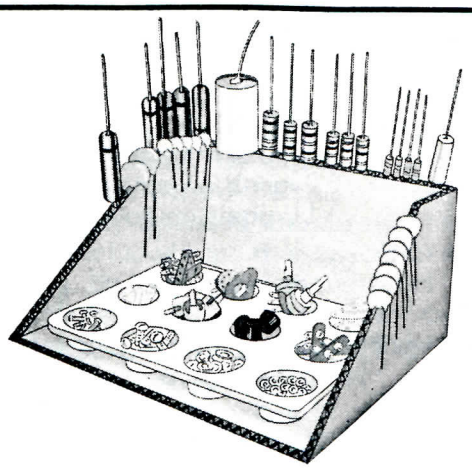
Most kit builders find it helpful to separate the various parts into convenient categories. Muffin tins or molded egg cartons make convenient trays for small parts. Resistors and capacitors may be placed with their lead ends inserted in the edge of a piece of corrugated cardboard until they are needed. Values can be written on the cardboard next to each component. The illustration shows one method that may be used.



# PARTS LIST

The numbers in parentheses in the Parts List are keyed to the numbers on the Parts Pictorial (fold-out from Page 5) to aid in parts identification.

| PART No. | PARTS Per Kit | DESCRIPTION |
|---|---|---|
| **RESISTORS** | | |
| **1/2 Watt** | | |
| (1) 1-1 | 1 | 47 Ω (yellow-violet-black) |
| 1-4 | 1 | 330 Ω (orange-orange-brown) |
| 1-94 | 1 | 390 Ω (orange-white-brown) |
| 1-95 | 1 | 560 Ω (green-blue-brown) |
| 1-96 | 1 | 750 Ω (violet-green-brown) |
| 1-97 | 5 | 1100 Ω (brown-brown-red) |
| 1-98 | 5 | 1600 Ω (brown-blue-red) |
| 1-90 | 1 | 2000 Ω (red-black-red) |
| 1-89 | 1 | 2400 Ω (red-yellow-red) |
| 1-16 | 1 | 4700 Ω (yellow-violet-red) |
| 1-20 | 2 | 10 KΩ (brown-black-orange) |
| 1-121 | 1 | 120 KΩ (brown-red-yellow) |
| 1-99 | 2 | 240 KΩ (red-yellow-yellow) |
| 1-87 | 2 | 330 KΩ (orange-orange-yellow) |
| 1-100 | 2 | 510 KΩ (green-brown-yellow) |
| 1-101 | 2 | 1 megohm (brown-black-green) |
| (2) 2-97 | 2 | 25 KΩ 1% |
| 2-98 | 2 | 33.3 KΩ 1% |
| 2-99 | 2 | 50 KΩ 1% |
| 2-11 | 2 | 100 KΩ 1% |

| PART No. | PARTS Per Kit | DESCRIPTION |
|---|---|---|
| **2 Watt and 20 Watt** | | |
| (3) 1-10-2 | 1 | 47 KΩ 2 watt (yellow-violet-orange) |
| (4) 3-2-20 | 1 | 5000 Ω 20 watt |
| **CAPACITORS** | | |
| (5) 20-1 | 1 | 47 μμf mica (yellow-violet-black) |
| 20-55 | 1 | 500 μμf mica (green-black-brown) |
| (6) 23-67 | 1 | .005 μfd tubular |
| 23-68 | 1 | .05 μfd tubular |
| 23-69 | 1 | .5 μfd tubular |
| (7) 25-5 | 1 | 16 μfd 150 V electrolytic |
| 25-16 | 1 | 20 μfd 350 V electrolytic |
| (8) 25-37 | 1 | 40-40 μfd 450 V electrolytic |
| **CONTROLS** | | |
| (9) 10-34 | 1 | 600 Ω |
| 10-7 | 1 | 5000 Ω |
| 10-8 | 1 | 10 KΩ |

| PART No. | PARTS Per Kit | DESCRIPTION |
|---|---|---|
| **SWITCHES** | | |
| (10) 60-1 | 2 | SPST slide |
| (11) 63-8 | 1 | 4-position rotary |
| 63-107 | 1 | 8-position rotary |
| 63-108 | 2 | 11-position rotary |
| **INSULATORS-TERMINAL STRIPS-SOCKETS** | | |
| (12) 73-1 | 3 | Rubber grommet |
| (13) 75-17 | 4 | Binding post insulator |
| (14) 75-71 | 1 | Strain relief insulator |
| (15) 100-16-2 | 1 | Binding post cap (black) |
| 100-16-18 | 1 | Binding post cap (red) |
| (16) 481-3 | 1 | Capacitor mounting wafer |
| (17) 431-45 | 1 | 6-lug terminal strip, one mounting foot |
| (18) 431-19 | 1 | 5-lug terminal strip, two mounting feet |
| (19) 431-23 | 1 | Terminal board |
| (20) 434-15 | 2 | 7-pin tube socket |
| 434-16 | 1 | 9-pin tube socket |
| (21) 434-47 | 1 | Pilot lamp socket |
| (22) 434-23 | 1 | Candelabra lamp socket |
| **HARDWARE** | | |
| (23) 250-2 | 6 | 3-48 x 5/16" screw |
| (24) 250-8 | 2 | #6 x 3/8" sheet metal screw |
| (25) 250-9 | 12 | 6-32 x 3/8" screw |
| 250-48 | 4 | 6-32 x 1/2" screw |
| (26) 250-83 | 2 | #10 x 1/2" sheet metal screw |
| (27) 252-1 | 6 | 3-48 nut |
| (28) 252-3 | 16 | 6-32 nut |
| (29) 252-7 | 7 | Control nut |
| (30) 253-9 | 4 | #8 flat steel washer |
| (31) 253-10 | 5 | Control flat washer |
| (32) 254-1 | 13 | #6 lockwasher |
| (33) 254-4 | 7 | Control lockwasher |
| (34) 259-1 | 2 | #6 solder lug |
| (35) 259-10 | 1 | Control solder lug |
| (36) 427-3 | 2 | Binding post base |

| PART No. | PARTS Per Kit | DESCRIPTION |
|---|---|---|
| **TUBES-LAMPS** | | |
| 411-11 | 1 | 6AU6 tube |
| 411-63 | 1 | 6CL6 tube |
| 411-64 | 1 | 6X4 tube |
| 412-4 | 1 | #50 pilot lamp |
| 412-2 | 1 | 3 watt candelabra lamp |
| **WIRE-SLEEVING** | | |
| 89-1 | 1 | Line cord |
| 340-2 | 1 | Bare wire |
| 344-51 | 1 | Brown hookup wire |
| 344-52 | 1 | Red hookup wire |
| 344-59 | 1 | White hookup wire |
| 346-1 | 1 | Small sleeving |
| 346-6 | 2 | Large sleeving |
| **METAL PARTS** | | |
| 90-235 | 1 | Cabinet |
| 200-580 | 1 | Chassis |
| 203-80-3 | 1 | Front panel |
| **MISCELLANEOUS** | | |
| 46-3 | 1 | Filter choke |
| 54-253 | 1 | Power transformer |
| (37) 56-26 | 3 | Crystal diode |
| 211-15 | 1 | Plastic handle |
| 261-9 | 4 | Rubber foot |
| (38) 421-17 | 1 | 3/4 ampere pigtail fuse |
| 407-85 | 1 | Meter |
| 462-187 | 5 | Knob |
| 490-5 | 1 | Nut starter |
| 597-308 | 1 | Kit Builders Guide |
| 597-260 | 1 | Parts Order Form |
| 391-34 | 1 | Blue and white label |
| | 1 | Manual (See front cover for part number.) |
| | | Solder |

To order replacement parts, refer to the Replacement Parts Price List and use the Parts Order Form furnished with this kit.

# PROPER SOLDERING TECHNIQUES

Only a small percentage of customers find it necessary to return equipment for factory service. By far the largest portion of malfunctions in this equipment is due to poor or improper soldering.

If terminals are bright and clean and free of wax, frayed insulation and other foreign substances, no difficulty will be experienced in soldering. Correctly soldered connections are essential if the performance engineered into a kit is to be fully realized. If you are a beginner with no experience in soldering, a half hour's practice with some odd lengths of wire may be a worthwhile investment.

For most wiring, a 25 to 100 watt iron or its equivalent in a soldering gun is very satisfactory. A lower wattage iron than this may not heat the connection enough to flow the solder smoothly. Keep the iron tip clean by wiping it from time to time with a cloth.

## CHASSIS WIRING AND SOLDERING

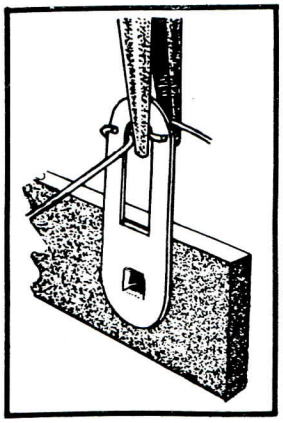
1. Unless otherwise indicated, all wire used is the type with colored insulation (hookup wire). In preparing a length of hookup wire, 1/4" of insulation should be removed from each end unless directed otherwise in the assembly step.

2. To avoid breaking internal connections when stripping insulation from the leads of transformers or similar components, care should be taken not to pull directly on the lead. Instead, hold the lead with pliers while it is being stripped.

3. Leads on resistors, capacitors, and similar components are generally much longer than need be to make the required connections. In these cases, the leads should be cut to proper length before the part is installed. In general, the leads should be just long enough to reach their terminating points.

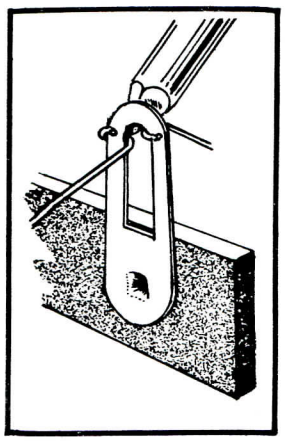
4. Wherever there is a possibility of bare leads shorting to other parts or to the chassis, the leads should be covered with insulating sleeving. Where the use of sleeving is specifically intended, the phrase "use sleeving" is included in the associated assembly step. In any case where there is the possibility of an unintentional short circuit, sleeving should be used. Extra sleeving is provided for this purpose.

5. Crimp or bend the lead (or leads) around the terminal to form a good joint without relying on solder for physical strength. If the lead is too large to allow bending or if the step states that it is not to be crimped, position it so that a good solder connection can still be made.



6. Position the work, if possible, so that gravity will help to keep the solder where you want it.

7. Place a flat side of the soldering iron tip against the joint to be soldered until it is heated sufficiently to melt the solder.



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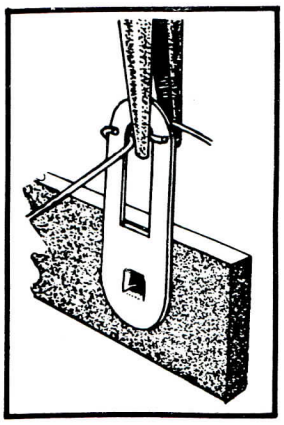

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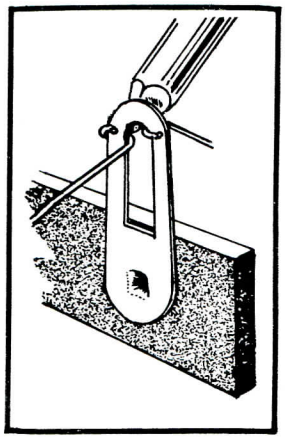
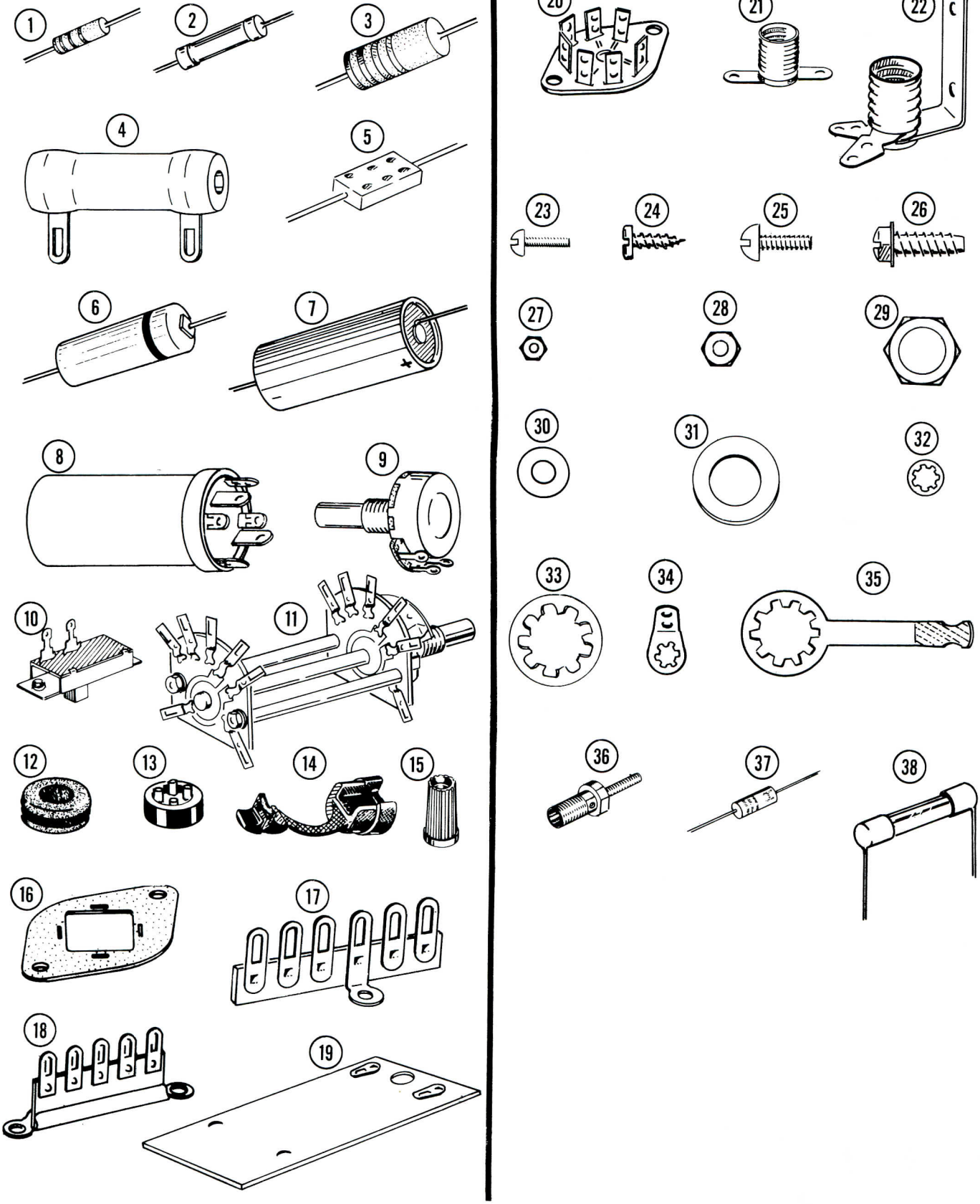


# PARTS PICTORIAL



# STEP-BY-STEP PROCEDURE

The following instructions are presented in a logical step-by-step sequence to enable you to complete your kit with the least possible confusion. Be sure to read each step all the way through before beginning the specified operation. Also read several steps ahead of the actual step being performed. This will familiarize you with the relationship of the subsequent operations. When the step is completed, check it off in the space provided. This is particularly important as it may prevent errors or omissions, especially if your work is interrupted. Some kit builders have also found it helpful to mark each wire and part in colored pencil on the Pictorial as it is added.

## ILLUSTRATIONS

The fold-out diagrams in this manual may be removed and attached to the wall above your working area; but because they are an integral part of the instructions, they should be returned to the manual after the kit is completed. In general, the illustrations in this manual correspond to the actual configuration of the kit; however, in some instances the illustrations may be slightly distorted to facilitate clearly showing all of the parts.

## SOLDERING

The abbreviation "NS" indicates that a connection should not be soldered yet as other wires will be added. When the last wire is installed, the terminal should be soldered and the abbreviation "S" is used to indicate this. Note that a number will appear after each solder instruction. This number indicates the number of leads that are supposed to be connected to the terminal in point before it is soldered. For example, if the instruction reads, "Connect a wire to lug 1 (S-2)," it will be understood that there will be two wires connected to the terminal at the time it is soldered. (In cases where a wire passes through a terminal or lug and then connects to another point, it will count as two wires, one entering and one leaving the terminal.)

# STEP-BY-STEP ASSEMBLY

## PARTS MOUNTING-CHASSIS

Refer to Pictorial 1 (fold-out from Page 11) for the following steps.

( ) Position the chassis on your work area as shown in the Pictorial.

( ) Install rubber grommets at HD, HE, and HF.

( ) Referring to Detail 1A, install a 9-pin tube socket at V2, using 3-48 x 5/16" screws and nuts. The socket must be mounted from the bottom of the chassis. Position the blank space of the socket as indicated by the arrow on the Pictorial.

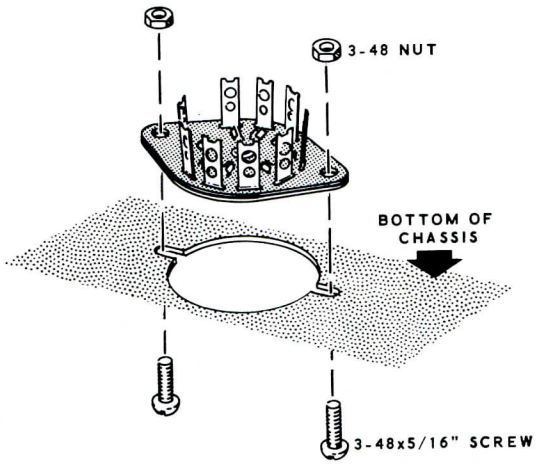
( ) In a like manner, install 7-pin tube sockets at V1 and V3, using 3-48 x 5/16" screws and 3-48 nuts. Position the blank space of each socket as indicated by the arrows on the Pictorial.

NOTE: When mounting the following parts, lockwashers and nuts will be used with all screws, unless stated otherwise in the assembly steps. Consequently, the following steps will call out only the size and type of hardware to be used. For example, the phrase "Use 6-32 x 3/8" hardware" means to use 6-32 x 3/8" screws, #6 lockwashers, and 6-32 nuts.

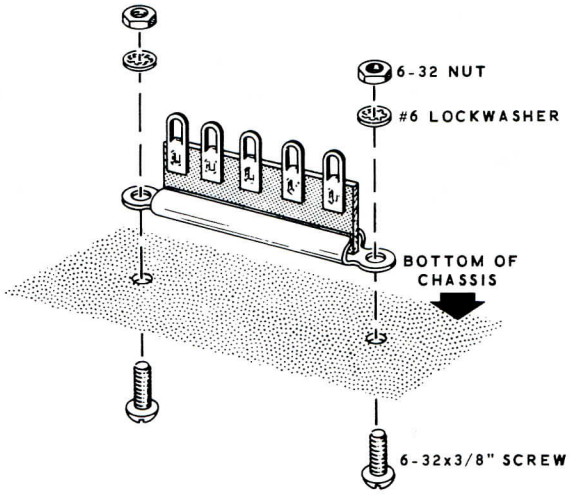
( ) Referring to Detail 1B, install a 5-lug terminal strip (two mounting feet) at L. Use 6-32 x 3/8" hardware.

( ) Referring to Detail 1C, install a 600 Ω control (#10-34) at N, using a control lockwasher and a control nut. If there is a locating tab on this control, bend it inward (toward the control shaft) so it does not hit the chassis. Do not tighten the nut at this time.

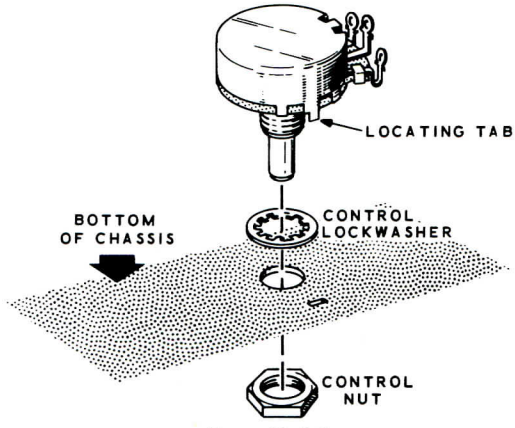
( ) Referring to Detail 1C, install a 10 KΩ control (#10-8) at P, using a control lockwasher and a control nut. Position controls N and P as shown and tighten their control nuts.



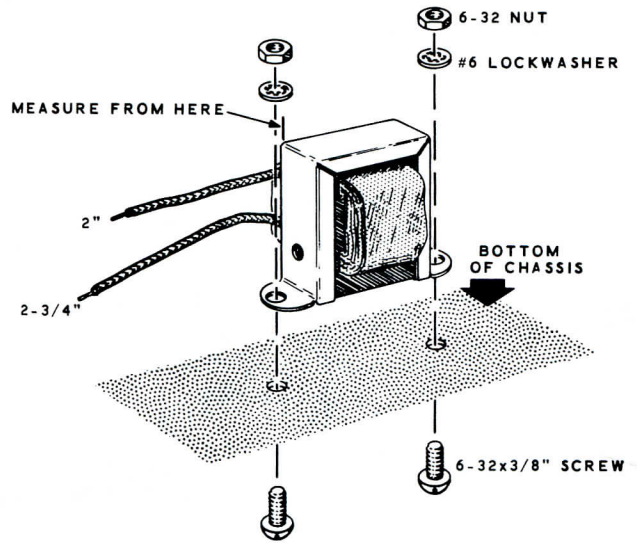

**Detail 1A**




**Detail 1B**



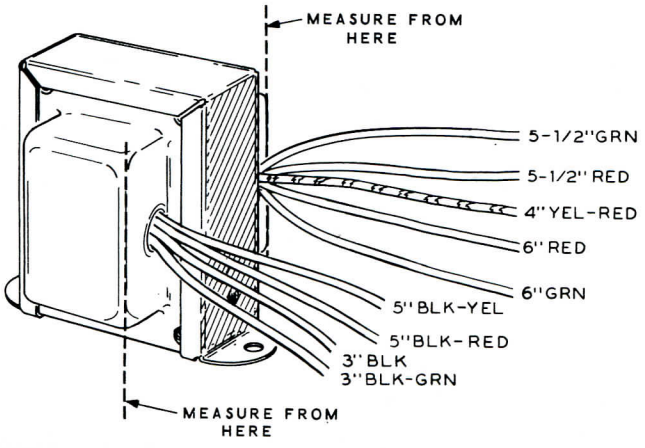

**Detail 1C**




**Detail 1D**

( ) Referring to Detail 1D, locate the filter choke (#46-3) and cut the leads to the indicated lengths. Measure the leads from where they come out of the choke. Strip 1/4" insulation from the end of each lead and melt a small amount of solder on the exposed lead ends.

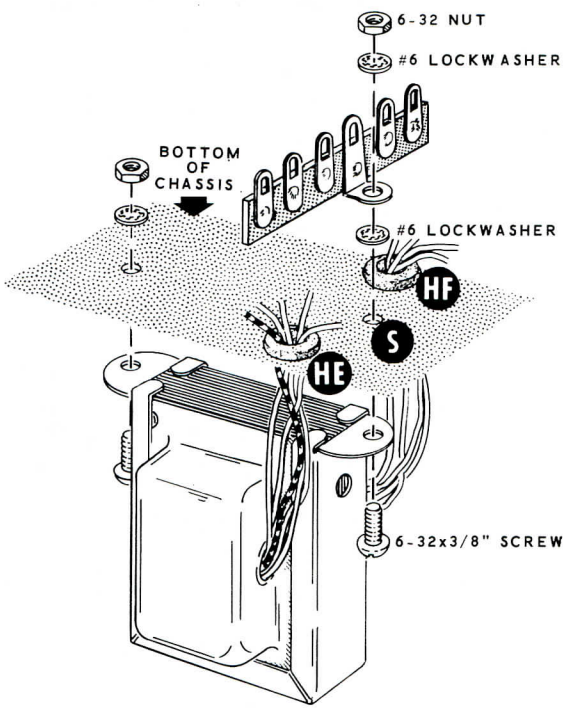
( ) Referring to Detail 1D, install the filter choke, using 6-32 x 3/8" hardware. Position the choke as shown.



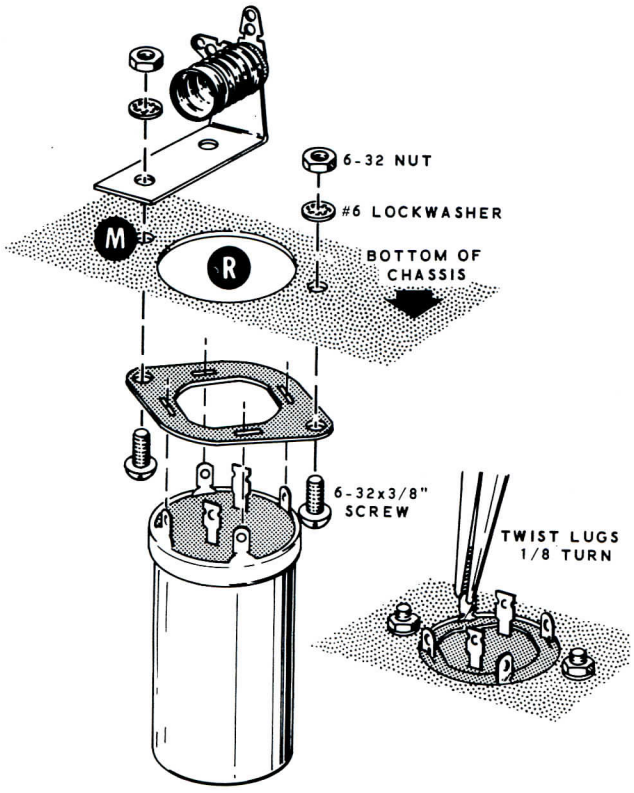

**Detail 1E**

( ) Referring to Detail 1E, locate the power transformer (#54-253) and cut the leads to the indicated lengths. Measure the leads from where they come out of the transformer. After cutting the leads to length, strip 1/4" insulation from the end of each lead and melt a small amount of solder on the exposed lead ends.

( ) Refer to Detail 1F and install the power transformer with a 6-lug terminal strip (one mounting foot) at S, using 6-32 x 3/8" hardware. The black, black-red, black-yellow, and black-green leads go through grommet HF and the remaining leads go through grommet HE. Position the terminal strip as shown.




**Detail 1F**




**Detail 1G**

Refer to Detail 1G for the following steps.

( ) Install the filter capacitor mounting wafer at R with the candelabra socket at M. Use 6-32 x 3/8" hardware. Be sure to install the capacitor mounting wafer on top of the chassis.

( ) Install the 40-40 μfd electrolytic capacitor (#25-37) at R. Position the capacitor lug markings as shown. Twist the lugs 1/8 turn.

Set the chassis aside temporarily.

## PARTS MOUNTING-FRONT PANEL

Refer to Pictorial 2 for the following steps.

Locate the front panel and place it on a soft cloth on your work area. This will help prevent the panel from being scratched while mounting the parts in the following steps.

( ) Install the meter (#407-85) at B, using the lockwashers and nuts supplied with the meter. Do not overtighten this hardware as the meter may be damaged.

( ) Referring to inset drawing A on Pictorial 2, install the pilot lamp socket on the terminal board. Solder both lugs.

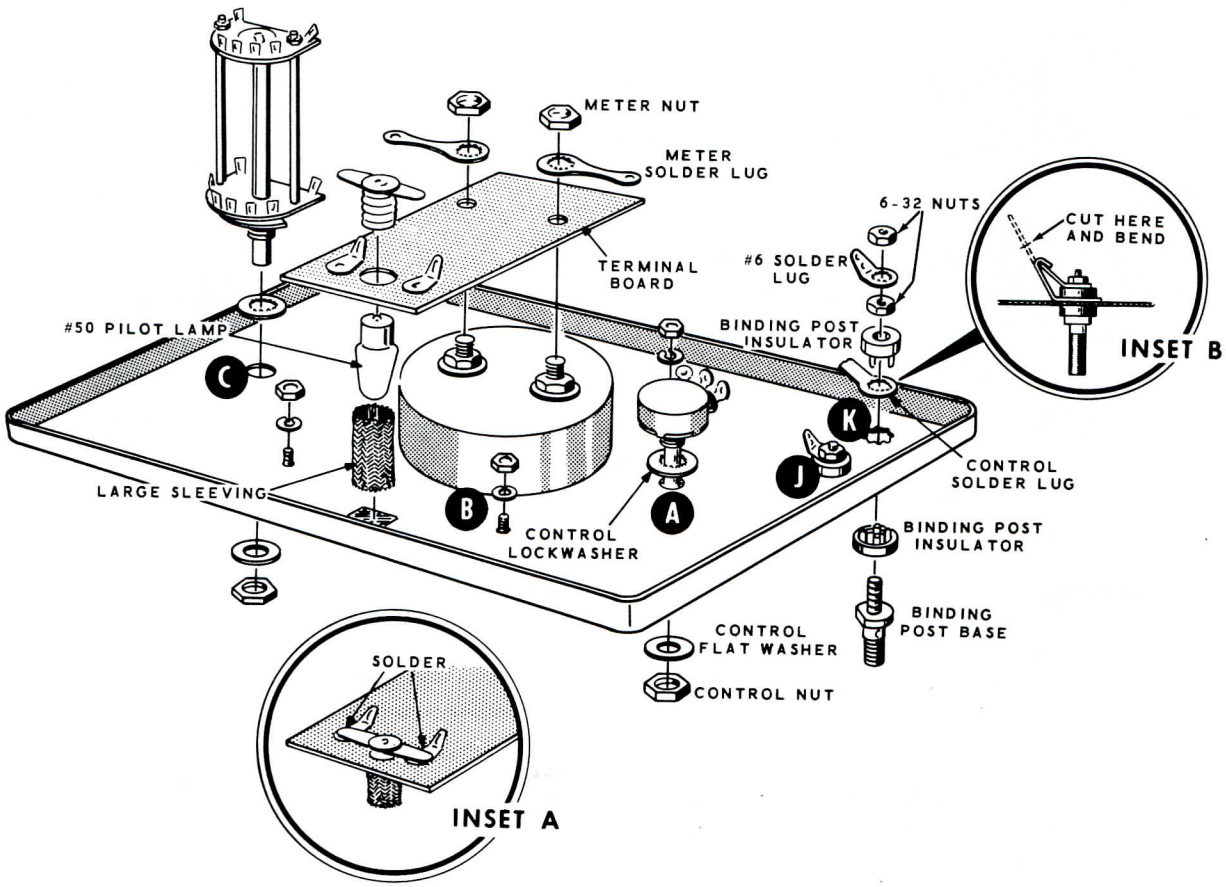
( ) Install the #50 pilot lamp in the pilot lamp socket.

( ) Place one length of large sleeving over the pilot lamp and the socket.

( ) Remove the shorting wire from between the meter terminals.

( ) Very carefully remove one nut and a solder lug from each meter terminal. It may be necessary to hold the bottom (front) nut with pliers to prevent loosening the meter terminals.

( ) Install the terminal board on the meter terminals. Secure the board with the solder lugs and nuts just removed from the meter. Position the terminal board and solder lugs as shown. If necessary, bend the pilot lamp socket so the pilot lamp is directly behind the small hole at the top of the front panel.



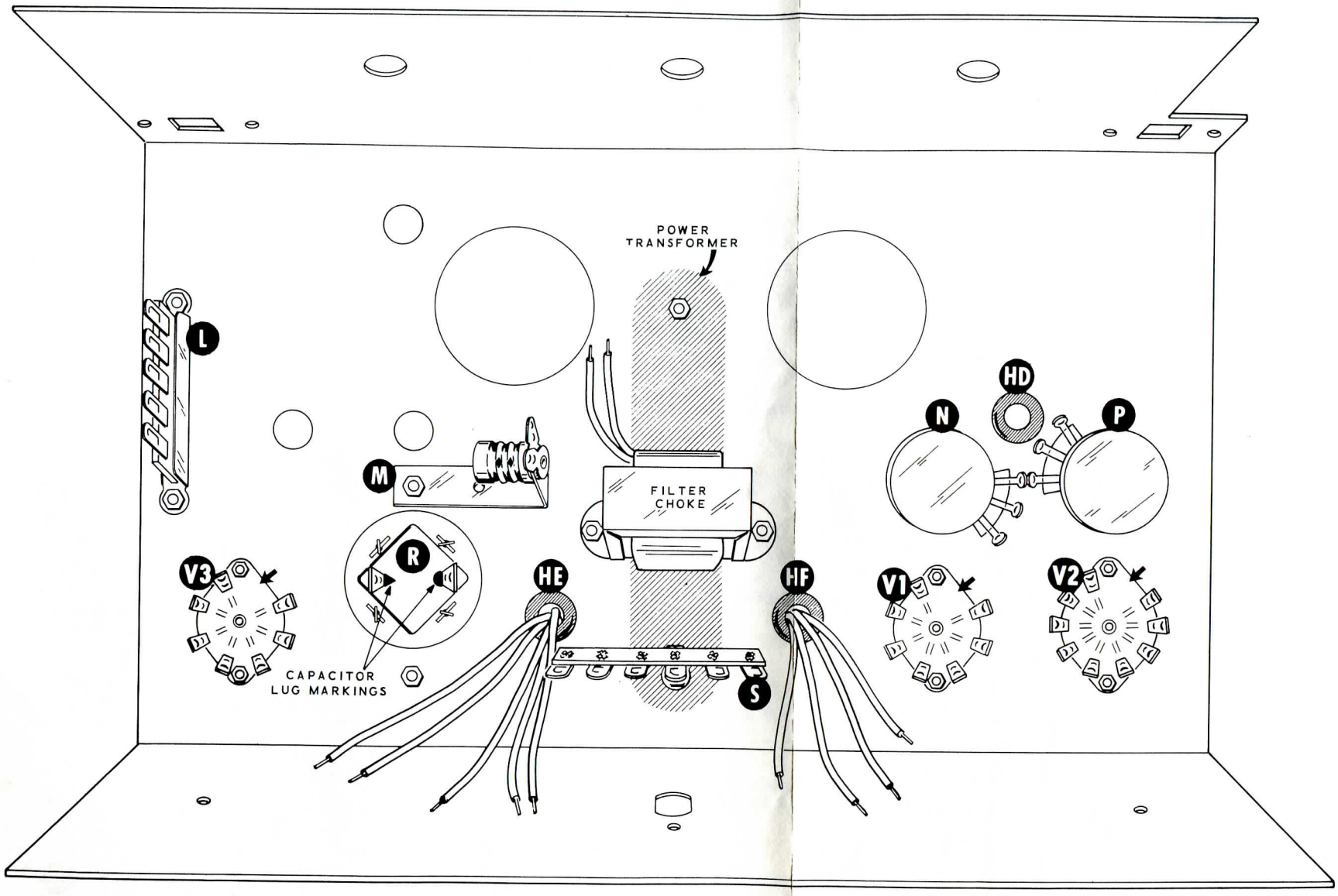

## PICTORIAL 2

( ) Install a 5000 Ω control (#10-7) at A, using a control lockwasher, control flat washer, and a control nut. Position the control lugs as shown.

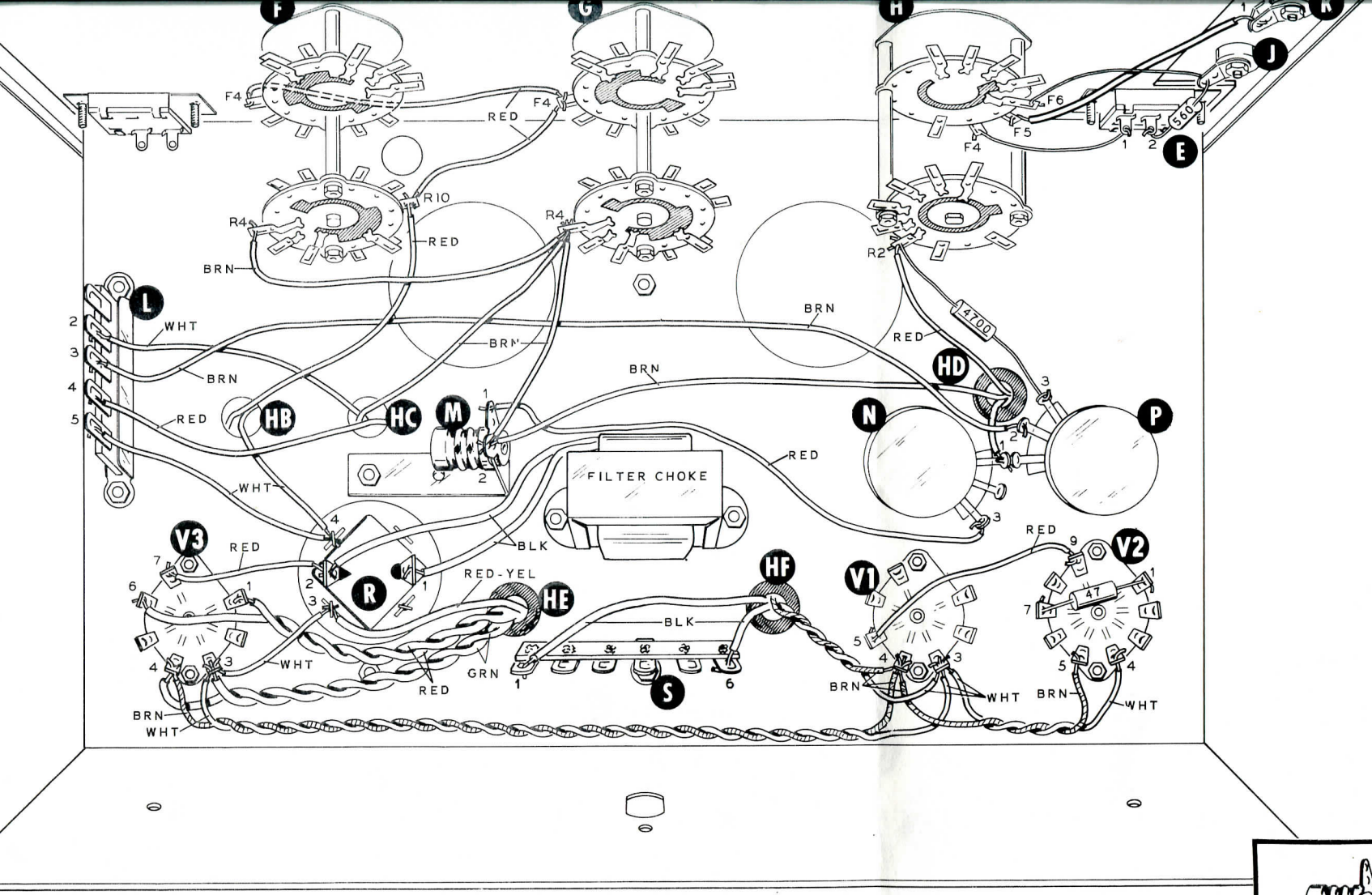
( ) Install the 4-position switch (#63-8) at C. Use a control lockwasher, control flat washer, and a control nut. Position the switch lugs as shown.

( ) Referring to inset drawing B of Pictorial 2, install a binding post base at K. Use two binding post insulators, a control solder lug, a #6 solder lug, and two 6-32 nuts. Bend and cut off the control solder lug as shown.

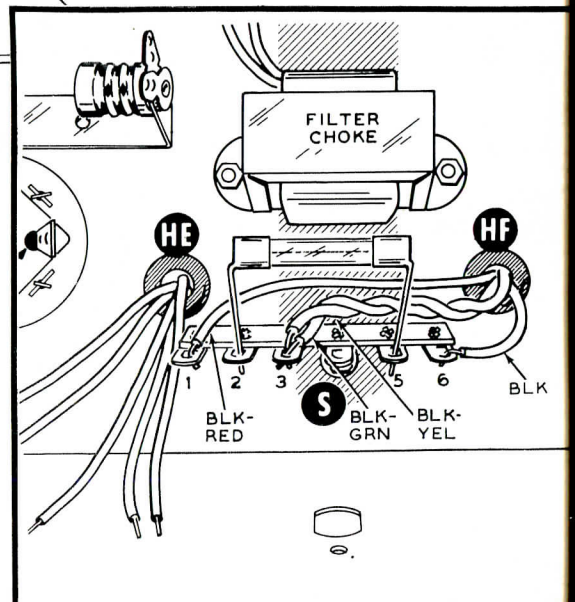
( ) Install a binding post base at J, using two binding post insulators, a #6 solder lug, and two 6-32 nuts.

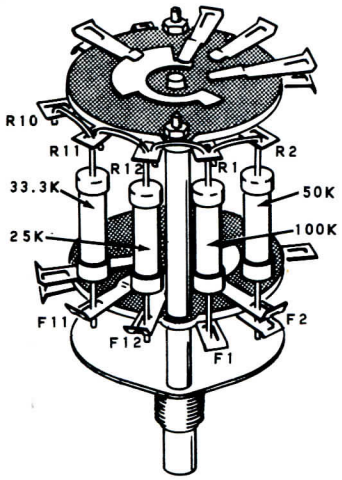

POWER
TRANSFORMER
L
M
R
FILTER
CHOKE
HD
N
P
V3
HE
HF
V1
V2
S
CAPACITOR
LUG MARKINGS

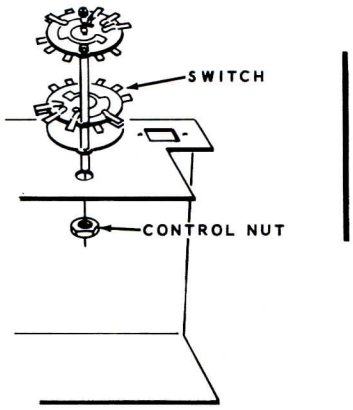
**PICTORIAL 1**

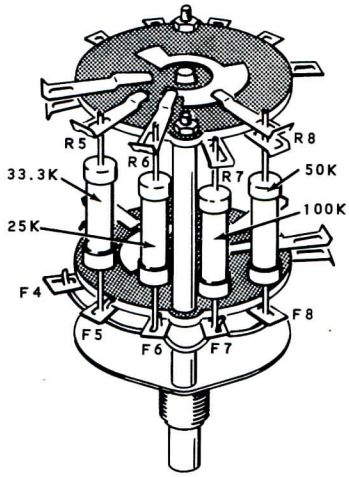

F
G
H
J
K
E
L
HB
HC
M
N
P
HD
HE
HF
R
S
V1
V2
V3
F4
F5
F6
R10
R4
R2
RED
BRN
WHT
BLK
GRN
RED-YEL
560
4700
47
FILTER CHOKE

**PICTORIAL 4**


FILTER CHOKE
HE
HF
S
BLK-RED
BLK-GRN
BLK-YEL
BLK




**Detail 3A** **Detail 3B**

## SWITCH WIRING

In the following six Details, the rotary switches will be wired. It is helpful if each switch is temporarily installed on the chassis while being wired. See Detail 3A.

The letter on a lug identifies the switch wafer, front (F) or rear (R), the number identifies the lug on that wafer. Where there is a lug on both sides of a wafer at one location, the connection should be made to both lugs. All switch positions (holes) do not have lugs, but are numbered to keep lug numbering consistent.

Refer to Detail 3A for the following steps.

( ) Locate an 11-position switch (#63-108) and be sure the shaft is rotated full counter-clockwise when looking at the shaft (front) end. Position the switch as shown.

NOTE: All resistors are 1/2 watt unless otherwise specified.

( ) Pass one lead of a 33.3 KΩ 1% resistor through lug R11 (NS) to lug R10 (NS). Connect the other lead to lug F11 (S-1).

( ) Pass one lead of a 25 KΩ 1% resistor through lug R12 (NS) to lug R11 (S-3). Connect the other lead to lug F12 (S-1).

( ) Pass one lead of a 100 KΩ 1% resistor through lug R1 (NS) to lug R12 (S-3). Connect the other lead to F1 (S-1). Be sure the lead between lugs R1 and R12 does not touch the switch bolt.

( ) Pass one lead of a 50 KΩ 1% resistor through lug R2 (S-2) to lug R1 (S-3). Connect the other lead to lug F2 (S-1). Be sure to solder both lugs at F2.

Refer to Detail 3B for the following steps.

( ) Position the switch as shown in the Detail.

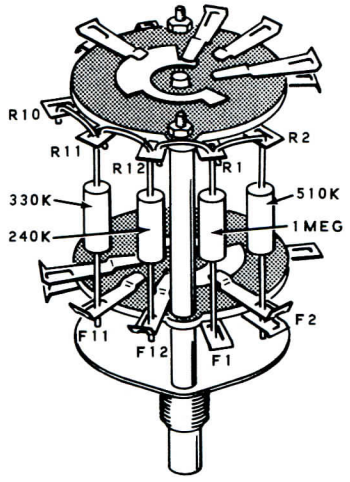
( ) Pass one lead of a 33.3 KΩ 1% resistor through lug F5 (NS) to lug F4 (NS). Connect the other lead to lug R5 (S-1).

( ) Pass one lead of a 25 KΩ 1% resistor through lug F6 (NS) to lug F5 (S-3). Connect the other lead to lug R6 (S-1).

( ) Pass one lead of a 100 KΩ 1% resistor through lug F7 (NS) to lug F6 (S-3). Connect the other lead to lug R7 (S-1). Be sure the lead between lugs F6 and F7 does not touch the switch bolt.

( ) Pass one lead of a 50 KΩ 1% resistor through lug F8 (S-2) to lug F7 (S-3). Connect the other lead to lug R8 (S-1). Be sure both lugs at R8 are soldered.

Set this switch aside temporarily.




**Detail 3C**

Refer to Detail 3C for the following steps.

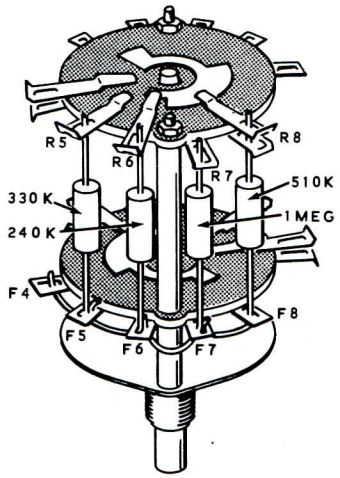
( ) Locate the remaining 11-position switch (#63-108) and rotate the shaft fully counter-clockwise when looking at the shaft (front) end. Position the switch as shown by the position of the rotor.

( ) Pass one lead of a 330 KΩ (orange-orange-yellow) resistor through lug R11 (NS) to lug R10 (NS). Connect the other lead to F11 (S-1).

( ) Pass one lead of a 240 KΩ (red-yellow-yellow) resistor through lug R12 (NS) to lug R11 (S-3). Connect the other lead to lug F12 (S-1).

( ) Pass one lead of a 1 megohm (brown-black-green) resistor through lug R1 (NS) to lug R12 (S-3). Connect the other lead to lug F1 (S-1). Be sure the lead between lugs R1 and R12 does not touch the switch bolt.

( ) Pass one lead of a 510 KΩ (green-brown-yellow) resistor through lug R2 (S-2) to lug R1 (S-3). Connect the other lead to lug F2 (S-1). Be sure both lugs at F2 are soldered.




**Detail 3D**

Refer to Detail 3D for the following steps.

( ) Position the switch as shown in the Detail.

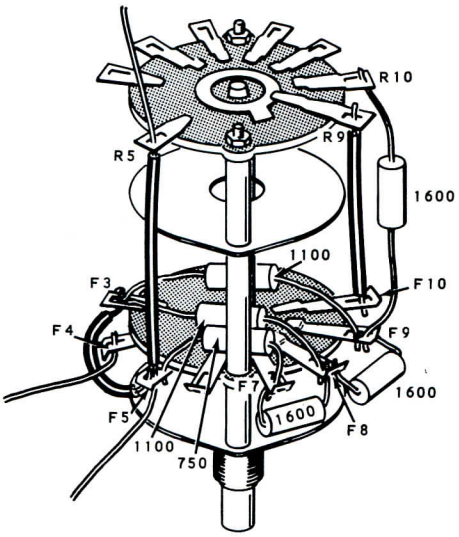
( ) Pass one lead of a 330 KΩ (orange-orange-yellow) resistor through lug F5 (NS) to lug F4 (NS). Connect the other end to lug R5 (S-1).

( ) Pass one lead of a 240 KΩ (red-yellow-yellow) resistor through lug F6 (NS) to lug F5 (S-3). Connect the other lead to lug R6 (S-1).

( ) Pass one lead of a 1 megohm (brown-black-green) resistor through lug F7 (NS) to lug F6 (S-3). Connect the other lead to lug R7 (S-1). Be sure the lead between lugs F6 and F7 does not touch the switch bolt.

( ) Pass one lead of a 510 KΩ (green-brown-yellow) resistor through lug F8 (S-2) to lug F7 (S-3). Connect the other lead to lug R8 (S-1). Be sure both lugs at R8 are soldered.

Set this switch aside temporarily.




**Detail 3E**

Refer to Detail 3E for the following steps.

( ) Locate the 8-position switch (#63-107) and rotate the shaft fully counterclockwise when looking at the shaft (front) end. Position the switch as shown.

NOTE: When both leads of a resistor are connected to the same wafer, position the body of the resistor so it does not touch the switch.

( ) Connect a 750 Ω (violet-green-brown) resistor between lugs F5 (NS) and F7 (NS). Position the resistor as shown.

( ) Pass one lead of an 1100 Ω (brown-brown-red) resistor through lug F3 (NS) to lug F5 (NS). Place a 5/8" length of sleeving on the lead between lugs F3 and F5. Connect the other lead to lug F8 (NS).

( ) Connect an 1100 Ω (brown-brown-red) resistor between lugs F3 (S-3) and F9 (NS).

( ) Connect a 1600 Ω (brown-blue-red) resistor between lugs F7 (S-2) and F8 (NS).

( ) Connect a 1600 Ω (brown-blue-red) resistor between lugs F8 (S-3) and F9 (NS).

NOTE: In steps calling for only one end of a wire to be connected, the other end will be connected later.

( ) Connect one end of a 1-1/4" bare wire to lug F4 (S-1).

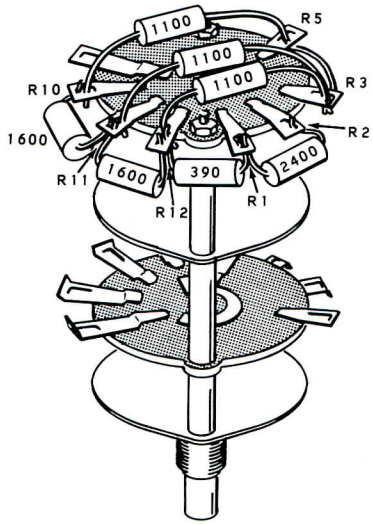
( ) Connect a 1600 Ω (brown-blue-red) resistor from lug F9 (S-3) to lug R10 (NS).

( ) Connect a 1-1/2" bare wire from lug F10 (S-1) to lug R9 (S-1). Place a 1" length of sleeving on this wire.

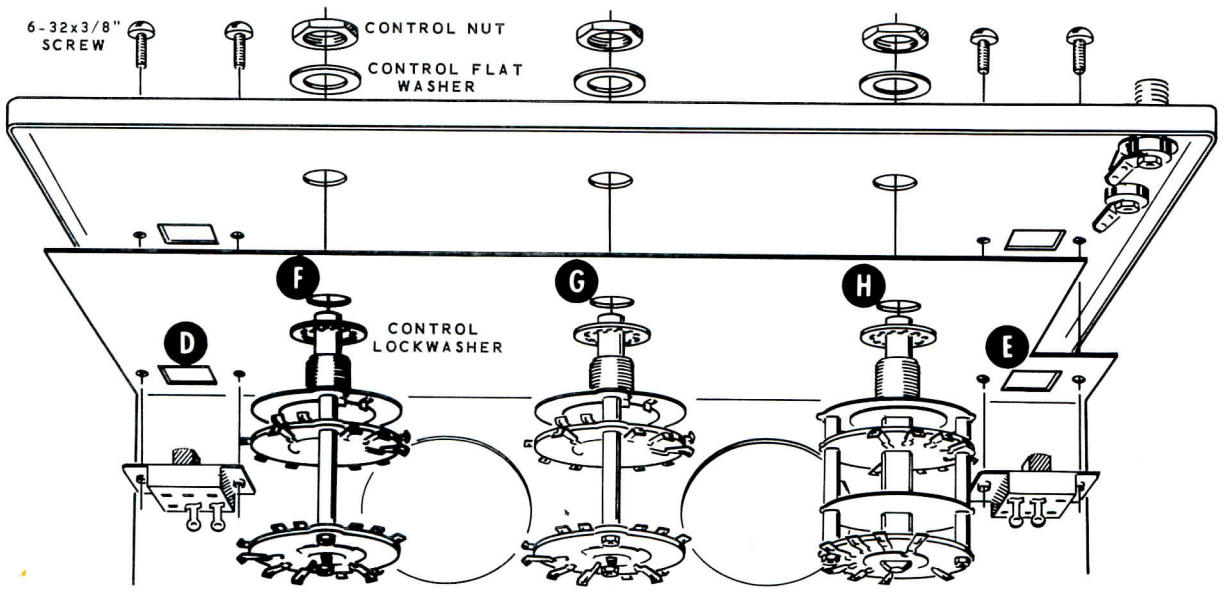
( ) Pass a 4-1/2" bare wire through lug R5 (NS) and through lug F5 (S-4). This wire should extend 1-1/2" from lug F5 and 1-5/8" from lug R5. Use a 1" length of sleeving between lugs F5 and R5.

Refer to Detail 3F for the following steps.

( ) Pass one lead of an 1100 Ω (brown-brown-red) resistor through lug R5 (S-4) to lug R3 (NS). Connect the other lead to lug R10 (NS).




**Detail 3F**




## PICTORIAL 3

( ) Connect an 1100 Ω (brown-brown-red) resistor between lugs R3 (NS) and R12 (NS). Keep the resistor clear of the rotor and the lead clear of the switch bolt.

( ) Connect an 1100 Ω (brown-brown-red) resistor between lugs R3 (S-3) and R11 (NS). Keep the resistor clear of the rotor.

( ) Connect a 2400 Ω (red-yellow-red) resistor between lugs R1 (NS) and R2 (NS).

( ) Connect a 390 Ω (orange-white-brown) resistor between lugs R1 (S-2) and R12 (NS).

( ) Connect a 1600 Ω (brown-blue-red) resistor between lugs R11 (NS) and R12 (S-3).

( ) Connect a 1600 Ω (brown-blue-red) resistor between lugs R10 (S-3) and R11 (S-3).

Set this switch aside temporarily.

Refer to Pictorial 3 and to Pictorial 4 (fold-out from Page 12) for the following steps.

( ) Install the front panel on the chassis with SPST slide switches at D and E. Use 6-32 x 3/8" screws. Position the switch lugs as shown. Be sure the three remaining front panel and chassis holes line up properly before tightening the switch screws.

( ) Install switch F (11-position switch with 1% resistors) on the chassis. Use a control lockwasher, control flat washer, and a control nut. Position the switch with the lugs as shown in Pictorial 4.

( ) In a like manner, install switch G (remaining 11-position switch) on the chassis. Use a control lockwasher, control flat washer, and a control nut. Position the switch as shown in Pictorial 4.

( ) Install switch H (8-position switch) on the chassis. Use a control lockwasher, control flat washer, and a control nut. Position the switch as shown in Pictorial 4.

## TRANSFORMER WIRING

Refer to Pictorial 4 (fold-out from Page 12) for the following steps.

( ) Bend the lugs of the three tube sockets outward slightly as shown.

Connect the power transformer leads coming from grommet HE as follows:

( ) Twist together the two green leads. Connect the longer lead to lug 4 (NS) and the shorter lead to lug 3 (NS) of tube socket V3.

( ) Twist together the two red leads. Connect the longer lead to lug 6 (S-1) and the shorter lead to lug 1 (S-1) of tube socket V3.

( ) Connect the red-yellow lead to lug 3 of capacitor R (NS).

## ALTERNATE LINE VOLTAGE WIRING

NOTE: Two sets of line voltage wiring instructions are given below, one for 120 VAC and the other one for 240 VAC. USE ONLY THE INSTRUCTIONS THAT AGREE WITH THE LINE VOLTAGE IN YOUR AREA.

### 120 VAC Wiring

Connect the power transformer leads coming from grommet HF to terminal strip S, as follows:

( ) Twist the black-red lead and the black-yellow lead together. Connect both leads to lug 1 of terminal strip S (NS).

( ) Twist the black lead and the black-green lead together. Connect both leads to lug 6 of terminal strip S (NS).

( ) Locate the 3/4 ampere pigtail fuse and slide the remaining length of large sleeving over it. Connect one lead of the fuse to lug 2 (NS) and the other lead to lug 5 (NS) of terminal strip S.

Proceed to the WIRING-CHASSIS BOTTOM .

### 240 VAC Wiring

Refer to Detail 4A (fold-out from Page 12).

Connect the power transformer leads coming from grommet HF to terminal strip S, as follows:

( ) Twist the black-yellow lead and the black-green lead together. Connect both leads to lug 3 of terminal strip S (S-2).

( ) Connect the black-red lead to lug 1 of terminal strip S (NS).

( ) Connect the black lead to lug 6 of terminal strip S (NS).

NOTE: The fuse referred to in the next step is not supplied with this kit. It can be obtained locally.

( ) Slide the remaining length of large sleeving over a 3/8 ampere pigtail fuse. Connect one lead of the fuse to lug 2 (NS) and the other lead to lug 5 (NS) of terminal strip S.

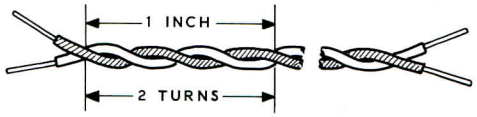
## WIRING-CHASSIS BOTTOM

Connect the filter choke leads to capacitor R as follows:

( ) Shorter black to lug 1 (NS).

( ) Longer black to lug 2 (NS).

( ) Referring to Detail 4B, twist together a 7" brown and a 7" white wire to obtain about two turns per inch. Strip 1/4" insulation from all four wire ends.




**Detail 4B**

( ) At either end of the twisted wires, connect the white wire to lug 3 (NS) and the brown, wire to lug 4 (S-2) of tube socket V3.

( ) At the other end of the twisted wires, connect the white wire to lug 3 (NS) and the brown wire to lug 4 (NS) of tube socket V1.

( ) In a like manner, twist together a 3" white wire and 3" brown wire. Strip 1/4" insulation from all four wire ends.

( ) At either end of the twisted wires, connect the white wire to lug 3 (NS) and the brown wire to lug 4 (NS) of tube socket V1.

( ) At the other end of the twisted wires, connect the white wire to lug 4 (S-1) and the brown wire to lug 5 (S-1) of tube socket V2.

( ) Connect a 1-3/4" white wire from lug 3 of tube socket V3 (S-3) to lug 3 of capacitor R (S-2).

( ) Twist together an 8-1/2" white wire and an 8-1/2" brown wire. Strip 1/4" insulation from all four wire ends.

( ) At either end of the twisted wires, connect the white wire to lug 3 (S-3) and the brown wire to lug 4 (S-3) of tube socket V1. Pass the other end of the twisted wires through grommet HF to be connected later.

To facilitate wiring in the following steps, precut the wires to the lengths listed at the beginning of each section. Remove 1/4" of insulation from each end of the wires and lay them in the sequence listed for quick identification.

( ) Prepare the following lengths of hookup wire:

| | |
|---|---|
| 2-3/4" white | 2" red |
| 4" white | 3-1/2" white |
| 5" red | 5" red |
| 7" white | 7-1/2" brown |

( ) Connect a 2-3/4" white wire from lug 5 of terminal strip L (NS) to lug 4 of capacitor R (NS).

( ) Connect one end of a 4" white wire to lug 4 of capacitor R (S-2). Pass the other end of the wire through hole HB to be connected later.

( ) Connect one end of a 5" red wire to lug 4 of terminal strip L (NS). Pass the other end of the wire through hole HC to be connected later.

( ) Connect one end of a 7" white wire to lug 2 of terminal strip L (NS). Pass the other end of the wire through hole HC to be connected later.

( ) Connect a 2" red wire from lug 7 of tube socket V3 (S-1) to lug 2 of capacitor R (S-2).

( ) Connect one end of a 3-1/2" white wire to lug 1 of control N (NS). Pass the other end through grommet HD to be connected later.

( ) Connect a 5" red wire from lug 1 of candelabra socket M (S-1) to lug 3 of control N (NS).

( ) Connect one end of a 7-1/2" brown wire to lug 2 of candelabra socket M (NS). Pass the other end through grommet HD to be connected later.

( ) Prepare the following lengths of hookup wire:

| | |
|---|---|
| 8" brown | 4" brown |
| 2-1/2" red | 1-1/2" brown |
| 3" red | 5" red |
| 2" red | 4-1/4" red |
| 3" brown | |

( ) Connect an 8" brown wire from lug 3 of terminal strip L (NS) to lug 2 of control P (S-1).

( ) Connect a 2-1/2" red wire from lug 5 of tube socket V1 (S-1) to lug 9 of tube socket V2 (S-1).

( ) Connect a 3" red wire from lug F4 of switch F (S-2) to lug F4 of switch G (NS). Position the wire as shown, keeping it clear of the rotor and shaft of the switch.

( ) Connect a 2" red wire from lug R10 of switch F (NS) to lug F4 of switch G (S-3).

( ) Connect a 3" brown wire from lug R4 of switch F (S-1) to lug R4 of switch G (NS). Be sure both lugs at R4 on switch F are soldered.

( ) Connect one end of a 4" brown wire to lug R4 of switch G (NS). Pass the other end through hole HC to be connected later.

( ) Connect a 1-1/2" brown wire from lug R4 of switch G (S-3) to lug 2 of candelabra socket M (NS). Be sure that both lugs at R4 on the switch are soldered.

( ) Connect one end of a 5" red wire to lug R10 (NS). Pass the other end through hole HB to be connected later.

( ) Place a 1" length of sleeving on the bare wire coming from lug F5 of switch H. Then connect this wire to solder lug K (S-1). Be sure the control solder lug is soldered to solder lug K.

( ) Connect the bare wire coming from lug F4 of switch H, to lug 1 of switch E (S-1).

( ) Pass one lead of a 560 Ω (green-blue-brown) resistor through solder lug J (S-2) to lug F6 of switch H (S-1). Connect the other lead to lug 2 of switch E (S-1).

( ) Connect a 4700 Ω (yellow-violet-red) resistor from lug R2 of switch H (NS) to lug 3 of control P (S-1).

( ) Connect one end of a 4-1/4" red wire to lug R2 of switch H (S-3). Pass the other end through grommet HD to be connected later.

( ) Connect a 47 Ω (yellow-violet-black) resistor between lugs 1 (S-1) and 7 (NS) of tube socket V2.

Refer to Pictorial 5 (fold-out from Page 19) for the following steps.

( ) Cut and twist together an 11" red wire and an 11" brown wire. Strip 1/4" insulation from all four wire ends.

( ) At either end of the twisted wires, connect the red wire to lug 1 (S-1) and the brown wire to lug 2 (S-1) of switch D.

( ) Position the twisted wires as shown. Connect the other end of the red wire to lug 2 of terminal strip S (S-2). If you used the 120 VAC wiring instructions, connect the other end of the brown wire to lug 6 of terminal strip S (S-3). If you used the 240 VAC wiring instructions connect the other end of the brown wire to lug 6 of terminal strip S (S-2).

( ) Position the twisted wires as shown and at the other end, connect the red wire to lug 2 (NS) and the brown wire to lug 5 (S-2) of terminal strip S.

( ) Prepare the following lengths of hookup wire.

| | |
|---|---|
| 5-1/2" white | 3-3/4" white |
| 7-1/4" red | 3" white |
| 3" red | 4-1/2" white |

( ) Place a 1-1/4" length of sleeving on the bare wire coming from lug R5 of switch H. Then pass the end of this wire through lug 1 of control P (NS) to lug 1 of control N (NS).

( ) Strip 5/8" insulation from one end of a 5-1/2" white wire. Pass the end of this wire with the 5/8" insulation removed, through lug 2 (NS) to lug 1 (S-3) of control N. Connect the other end of the wire to lug 5 of capacitor R (S-1). Be sure lug 1 of controls N and P are soldered together.

( ) Pass one lead of a 330 Ω (orange-orange-brown) resistor through lug 7 (S-2) to lug 2 (NS) of tube socket V1. Connect the other lead to lug 3 of control N (S-2). Position the lead between lugs 2 and 7 so it will not touch the tube pins when the tube is installed.

( ) Connect a 7-1/4" red wire from lug 1 of capacitor R (S-2) to lug 3 of tube socket V2 (NS).

( ) Connect a 3" red wire from lug R10 of switch F (S-4) to lug R10 of switch G (S-2).

( ) Connect one end of a 3-3/4" white wire to lug F10 of switch F (NS). Position the other end of the wire through hole HA to be connected later.

( ) Connect a 3" white wire from lug F10 of switch F (S-2) to lug F10 of switch G (NS). Keep the wire clear of the rotor and shaft of the switch. Be sure both lugs on switch F are soldered.

( ) Connect a 4-1/2" white wire from lug F10 of switch G (S-2) to lug 1 of tube socket V1 (S-1). Be sure that both lugs on the switch are soldered.

( ) Pass one lead of a 120 KΩ (brown-red-yellow) resistor through lug 8 (S-2) to lug 3 (NS) of tube socket V2. Place a 1" length of sleeving on the other lead and connect it to lug 6 of tube socket V1 (NS).

( ) Place a 1" length of sleeving on the positive (+) lead of a 16 μfd 150 V electrolytic capacitor and connect this lead to lug 6 of tube socket V1 (S-2).

( ) Place a 1-1/2" length of sleeving on the other lead of this capacitor and connect it to lug 2 of tube socket V1 (S-2). Position the capacitor as shown.

( ) Pass one lead of a 47 KΩ (yellow-violet-orange) 2 watt resistor through lug 6 (S-2) to lug 3 (S-3) and the other lead to lug 2 (S-1) of tube socket V2.

( ) Cut both leads of a 5000 Ω 20 watt resistor to 1". Place a 3/4" length of sleeving on each lead.

( ) Connect this resistor from lug 2 of control N (S-3) to lug 7 of tube socket V2 (NS). Position this resistor as shown in inset drawing #1 on Pictorial 5.

( ) Connect a 2000 Ω (red-black-red) resistor between lugs 1 (NS) and 4 (NS) of terminal strip L.

( ) Connect a 10 KΩ (brown-black-orange) resistor between lugs 4 (NS) and 5 (NS) of terminal strip L.

( ) Connect a 10 KΩ (brown-black-orange) resistor between lugs 2 (NS) and 5 (S-3) of terminal strip L.

Refer to inset drawing #2 on Pictorial 5 for the following steps.

NOTE: Crystal diodes will be connected in the following steps. Do not shorten the diode leads.

( ) Connect the lead at the banded end of a crystal diode to lug 1 (S-2) and the other lead to lug 2 (NS) of terminal strip L.

( ) Connect the lead at the banded end of a crystal diode to lug 2 (S-4) and the other lead to lug 3 (NS) of terminal strip L.

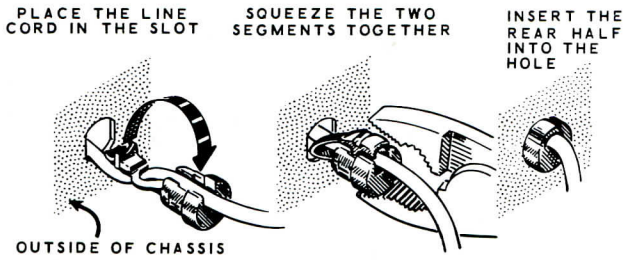
( ) Connect the lead at the banded end of a crystal diode, to lug 3 (S-3) and the other lead to lug 4 (S-4) of terminal strip L.

Position all three diodes as shown so they will not touch the cabinet when it is installed later.

( ) Locate the line cord. Twist the end strands of each lead together and melt a small amount of solder on the exposed lead ends.

( ) Pass the end of the line cord through hole HG. Connect either wire to lug 5 of terminal strip S (S-2). If you used the 120 VAC wiring instructions, connect the other wire to lug 1 of terminal strip S (S-3). If you used the 240 VAC wiring instructions, connect the other wire to lug 1 of terminal strip S (S-2).

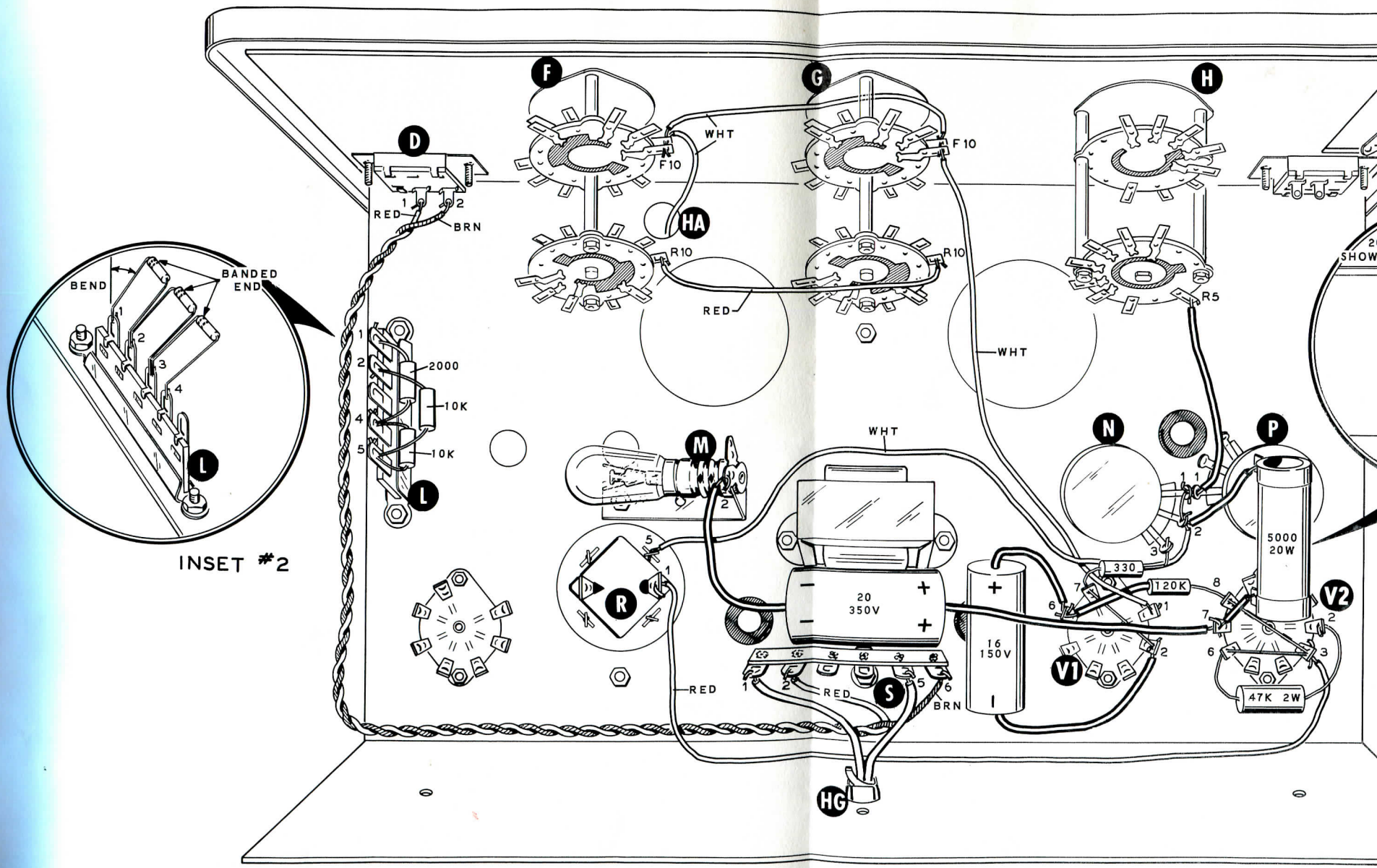
( ) Referring to Detail 5A, install the line cord strain relief in hole HG.



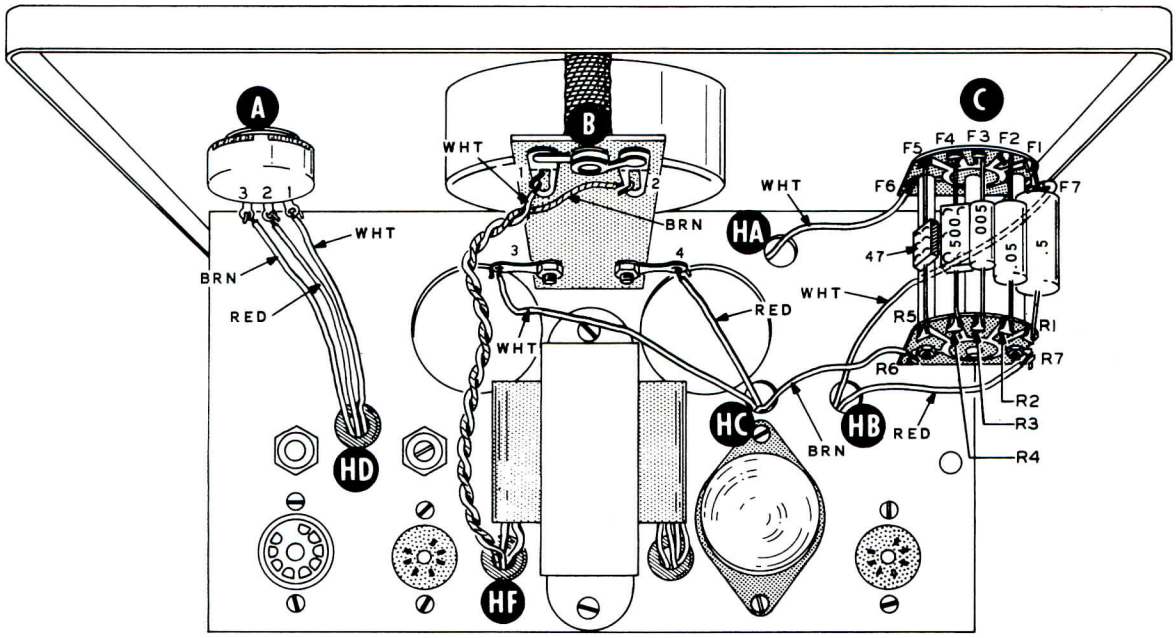

**Detail 5A**

( ) Place a 2" length of sleeving on each lead of a 20 μfd 350 V electrolytic capacitor. Connect the positive (+) lead to lug 7 of tube socket V2 (S-3) and the other lead to lug 2 of candelabra socket M (S-3). Position the capacitor as shown.

( ) Install the 3 watt candelabra lamp in socket M.


INSET #2
BEND
BANDED END
L
D
F
G
H
HA
HG
M
N
P
R
S
V1
V2
RED
BRN
WHT
F10
R10
R5
2000
10K
10K
20
350V
16
150V
330
120K
5000
20W
47K 2W

PICTORIAL 5




**PICTORIAL 6**

## WIRING-CHASSIS TOP

Refer to Pictorial 6 for the following steps.

Connect the wires coming from grommet HD to control A as follows:

( ) Brown, coming from lug 2 of candelabra socket M, to lug 3 (S-1).

( ) Red, coming from lug R2 of switch H, to lug 2 (S-1).

( ) White, coming from lug 1 of control N, to lug 1 (S-1).

Connect the wires coming from hole HC as follows:

( ) White, coming from lug 2 of terminal strip L, to lug 3 of terminal board B (S-1).

( ) Red, coming from lug 4 of terminal strip L, to lug 4 of terminal board B (S-1).

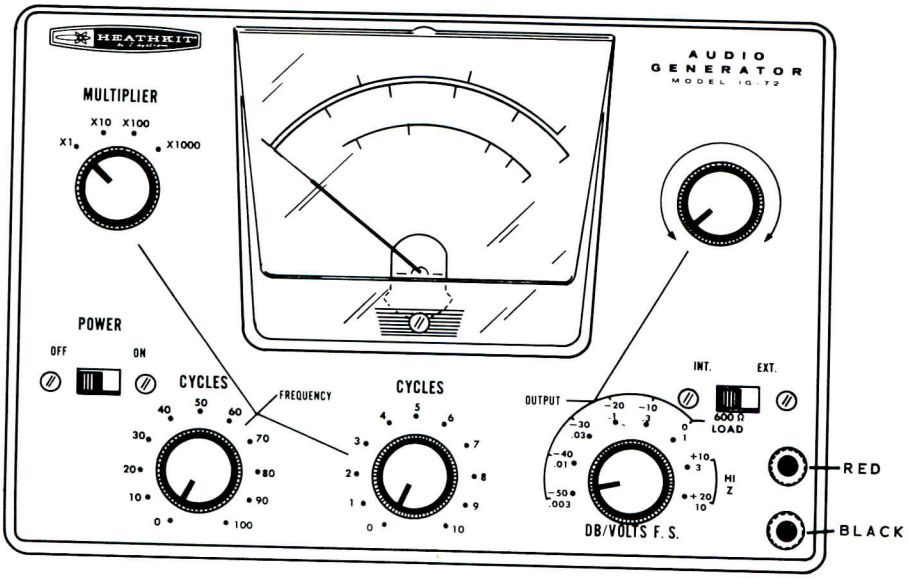
( ) Brown, coming from lug R4 of switch G, to lug R6 of switch C (S-1).

Connect the white and brown twisted wires coming from grommet HF, to terminal board B as follows:

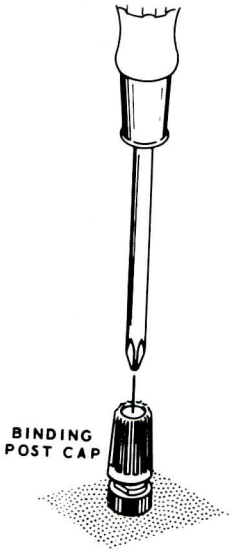
( ) White to lug 1 (S-1).

( ) Brown to lug 2 (S-1).

( ) Connect the white wire extending from hole HA, coming from lug F10 of switch F, to lug F6 of switch C (S-1).




Detail 6A




Detail 6B

Connect the wires coming from hole HB to switch C as follows:

(X) White, coming from lug 4 of capacitor R, to lug F7 (S-1).

(X) Red, coming from lug R10 of switch F, to lug R7 (S-1).

(X) Connect a 47 $\mu\mu$f (yellow-violet-black) mica capacitor between lugs F5 (S-1) and R5 (S-1) of switch C.

(X) Connect a 500 $\mu\mu$f (green-black-brown) mica capacitor between lugs F4 (S-1) and R4 (S-1) of switch C.

(X) Connect a .005 $\mu$fd tubular capacitor between lugs F3 (S-1) and R3 (S-1) of switch C.

(X) Connect a .05 $\mu$fd tubular capacitor between lugs F2 (S-1) and R2 (S-1) of switch C.

(X) Connect a .5 $\mu$fd tubular capacitor between lugs F1 (S-1) and R1 (S-1) of switch C.

This completes the wiring of the Audio Generator. Check to see that all connections are soldered. Shake out any wire clippings or solder splashes. Note that two lugs on terminal strip S are not used. These extra lugs are provided for special wiring in Audio Generators shipped abroad.

( ) Referring to Detail 6A, install a knob on each of the front panel control and switch shafts. Turn each shaft to its fully counterclockwise position. Place the pointer of each knob to the most counterclockwise marking on the front panel. The knob setscrew on the Multiplier switch should be tightened against the flat of the shaft. If the pointer on the knob does not line-up properly with the panel markings, loosen the switch nut and reposition the switch. Retighten the nut.

( ) Install the red binding post cap on the upper binding post base.

( ) Install the black binding post cap on the lower binding post base.

NOTE: Detail 6B shows how to keep the binding post caps from falling off. This is done by slightly spreading the open end of the binding posts with a phillips screwdriver after the binding post caps have been screwed on. Tap the screwdriver lightly.

# INITIAL TEST AND ADJUSTMENT

Refer to Figure 1 for the following steps.

( ) Install the tubes in their respective sockets.

( ) Set the Meter and Oscillator controls on top of the chassis to half rotation.

( ) Place the POWER switch in the OFF position.

( ) Plug the line cord into a 105-125 volt AC 50/60 cps outlet.

( ) Place the POWER switch in the ON position. The pilot lamp (at the top of the meter) should glow. After a few seconds, the tube filaments should also glow. If they do not glow turn the POWER switch OFF and check the filament circuit wiring. If other difficulties are encountered, turn the Generator OFF and refer to the In Case Of Difficulty section of the Manual.

( ) Turn the 0-100 CYCLES switch to the 10 or higher position.

( ) Advancing the OUTPUT control clockwise should show a slight indication on the meter.

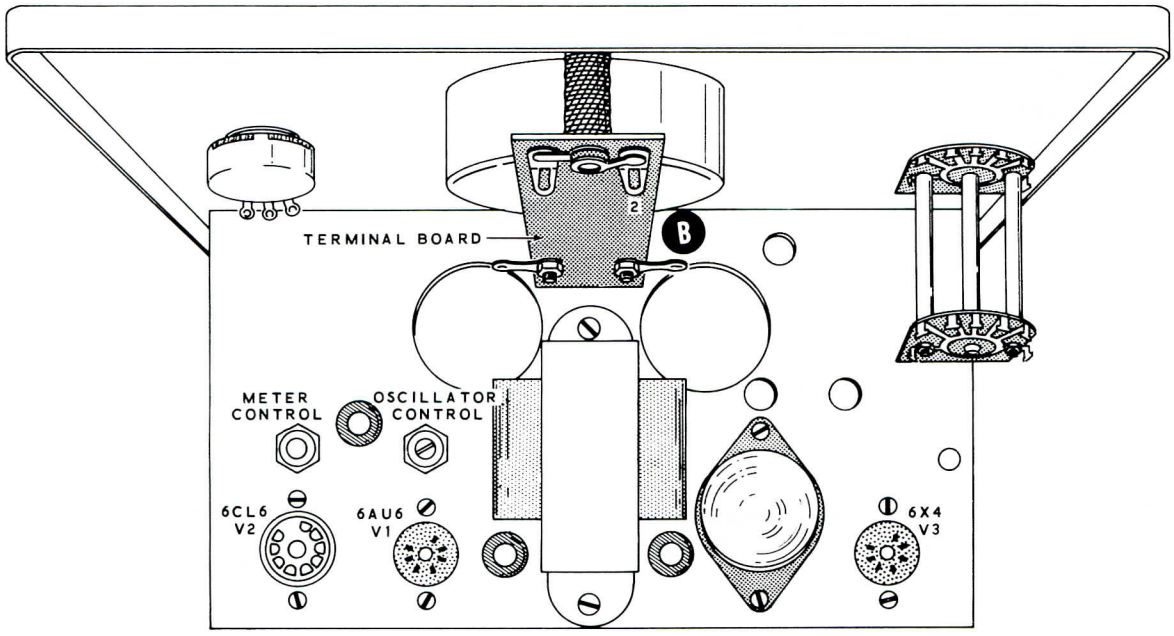



Figure 1

## METER CALIBRATION WITH AN AC VOLTMETER

NOTE: The AC voltmeter should have a sensitivity of at least 500 Ω per volt on the 10 volt scale.

Set the Generator controls as follows:

MULTIPLIER switch - X1.

0-100 CYCLES switch - 100.

0-10 CYCLES switch - 0.

OUTPUT control - fully clockwise.

DB/VOLTS switch - fully clockwise (10).

( ) Connect the AC voltmeter to the Generator Output binding posts.

( ) Adjust the Generator Meter control (on top of the chassis) so the AC voltmeter and Generator meters read the same.

( ) Disconnect the AC voltmeter from the Generator.

## METER CALIBRATION WITHOUT AN AC VOLTMETER

Set the Generator controls to the following positions:

MULTIPLIER - X1.
Both CYCLES switches - 0.
OUTPUT control - Fully clockwise.
DB/VOLTS switch - Fully clockwise (10).

CAUTION: Do not turn the OUTPUT control during the following adjustments. If it is not in the fully clockwise position, it may be damaged as the following adjustments are performed.

( ) Connect a wire between the red (top) Output binding post and lug 2 (brown wire) of the pilot lamp socket on terminal board B.

( ) Adjust the Meter control (on top of chassis) to obtain a reading of 6.3 on the 0 to 10 scale of the meter. Then remove the wire.

## OSCILLATOR ADJUSTMENT

Be sure all leads have been disconnected from the Output binding posts of the Generator. Then set the Generator controls as follows:

MULTIPLIER - X10.
0-100 CYCLES - 10.
0-10 CYCLES - 0.
OUTPUT control - fully clockwise.
DB/VOLTS switch - fully clockwise.

( ) Adjust the Oscillator control (on top of the chassis) for a slightly higher than full scale (10 on the 0-10 scale) meter reading.

( ) Move the MULTIPLIER switch through all positions. The meter should not indicate less than full scale on any of these ranges. If the meter indicates less than full scale, readjust the Oscillator control for a full scale (10 volts) meter reading. With the Oscillator control properly adjusted, the meter should indicate no less than full scale on each setting of the MULTIPLIER switch. A higher than normal output level on any range will cause distortion in the Generator output signal.

This completes the adjustments of the Generator.

# FINAL ASSEMBLY

Refer to Pictorial 7 for the following steps.

( ) Install the four rubber feet on the cabinet, using #8 flat washers and 6-32 x 1/2" hardware.

( ) Install the handle on the cabinet, using #10 x 1/2" sheet metal screws.

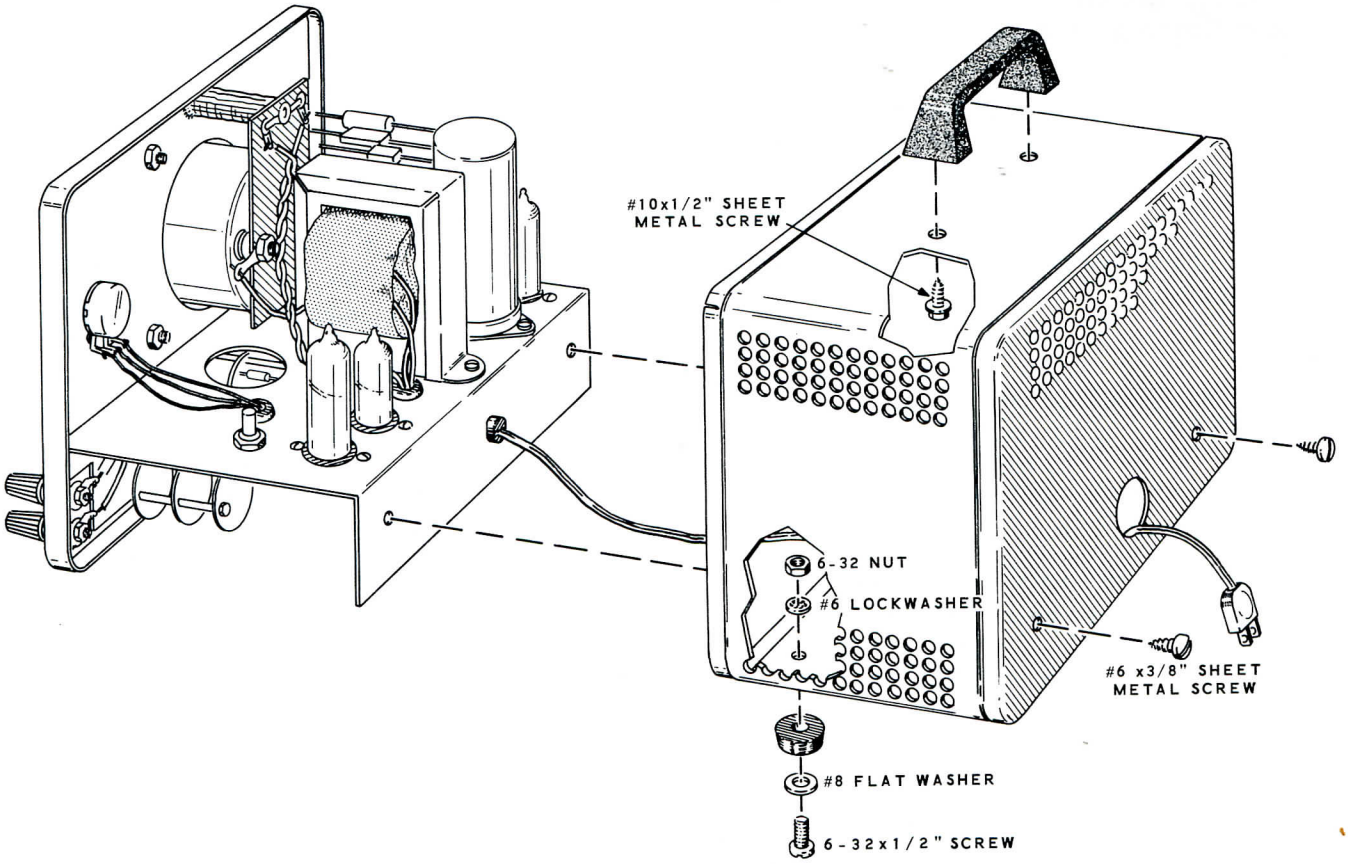
( ) Pass the line cord through the hole in the rear of the cabinet. Install the Generator in the cabinet, using #6 x 3/8" sheet metal screws.

NOTE: The blue and white identification label shows the Model Number and Production Series Number of your kit. Refer to these numbers in any communications with the Heath Company; this assures you that you will receive the most complete and up-to-date information in return.

( ) Install the identification label in the following manner:

1. Select a location for the label where it can easily be seen when needed, but will not show when the unit is in operation. This location might be on the rear panel or the top of the chassis, or on the rear or bottom of the cabinet.

2. Carefully peel away the backing paper. Then press the label into position.




PICTORIAL 7

# OPERATION

## OUTPUT TERMINATION

The output of the Audio Generator must be properly terminated to obtain accurate meter indications.

To obtain correct meter readings with a high impedance load (10 KΩ or more); set the 600 Ω LOAD switch to INTernal, and set the DB/VOLTS switch to the nearest full scale value above the desired output level. Then adjust the OUTPUT control to give the desired output on the proper meter scale. EXAMPLE: For an output voltage of 7.3 volts, set the DB/VOLTS switch to 10 volts. Then turn the OUTPUT control to give a 7.3 reading on the 0-10 scale of the meter. EXAMPLE: For an output of .025 volts, set the DB/VOLTS switch to .03 volts. Then turn the OUTPUT control to give a 2.5 reading on the 0-3 meter scale.

To obtain correct meter readings with an external 600 Ω load (1 volt maximum output signal level): set the LOAD switch to EXTernal and proceed as before.

## FREQUENCY SELECTION

To select the desired frequency, set the Generator controls as follows:

1. 0-100 CYCLES switch to the first significant figure.
2. 0-10 CYCLES switch to the second significant figure.
3. Turn the MULTIPLIER switch to the desired position.

EXAMPLE: For a frequency of 35 cps, set the 0-100 CYCLES switch to 30, the 0-10 CYCLES switch to 5 and the MULTIPLIER switch to X1.

EXAMPLE: For a frequency of 72 kc, set the 0-100 CYCLES switch to 70, the 0-10 CYCLES switch to 2 and the MULTIPLIER switch to X1000.

## DB/VOLTS SWITCH AND OUTPUT CONTROL

To select the desired output amplitude into a high impedance load (10 KΩ or higher) set the Generator controls as follows:

1. LOAD switch to INTernal.
2. DB/VOLTS switch to the nearest full scale value above the desired output.
3. OUTPUT control to give the desired output reading on the appropriate meter scale.

EXAMPLE: Desired voltage is 5.5 volts. Set the DB/VOLTS switch to 10. Then adjust the OUTPUT control for a 5.5 reading on the 0-10 voltmeter scale.

To select the desired output amplitude into an external 600 Ω load (.003 to 1 volt positions), set the LOAD switch to EXTernal and proceed as before.

## USING THE DB SCALE

The decibel is a unit of relative power. It may be applied to voltage levels if the impedances are identical. It may be used as a quantitative indication for one power or voltage level if the other level is defined. In this instrument, the db scale is based on a reference or standard level of 0 db= 1 milliwatt in 600 Ω. If used with a 600 Ω external load, the meter reading is expressed in dbm and the reference level is automatically defined.

If the instrument is used with loads differing from 600 Ω but substantially less than 10 KΩ, correction factors for the voltage reduction in the attenuator and for the db level may be calculated.

If the instrument is used with high impedance loads, the relation between two signal levels may be expressed as a number of db difference.

For example, if a device requires a signal of .61 volt on one input jack for a certain output, and a signal of .012 volt on another input jack for the same output, how many db difference between the two input jacks?

.61 volt is -2 db (on meter) ±0 db (on output switch) = -2.

.012 volt is -6 db (on meter) -30 db (on output switch) = -36.

Level difference is (-2) - (-36) = 34 db.

NOTE: Theoretically the input impedances should be equal in the above example. The method described is generally more useful than calculating the power level at each input using voltage and input impedance and using the formula:

$$db = 10 \log \frac{P_1}{P_2} = 10 \log \frac{E_1 2/R_1}{E_2 2/R_2}$$

for equal impedances this reduces to:

$$db = 10 \log \left(\frac{E_1}{E_2}\right)^2 = 20 \log \frac{E_1}{E_2}$$

Although theoretically correct, an erroneous impression may be gained by using the above approach; for instance changing a 10 KΩ grid resistor to 10 megohms decreases the power level by a factor of 100, or 30 db, yet the input voltage may remain unchanged.

## IN CASE OF DIFFICULTY

1. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the constructor.

2. It is interesting to note that about 90% of the kits that are returned for repair, do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure that they are soldered as described in the Proper Soldering Techniques section of this manual.

3. Check to be sure that all tubes are in their proper locations. Make sure that all tubes light up properly.

4. Check the tubes with a tube tester or by substitution.

5. Check the values of the parts. Be sure that the proper part has been wired into the circuit, as shown in the pictorial diagrams and as called out in the wiring instructions.

6. Check for bits of solder, wire ends or other foreign matter which may be lodged in the wiring.

7. If, after careful checks, the trouble is still not located and a voltmeter is available, check voltage readings against those shown on the Schematic Diagram. NOTE: All voltage readings were taken with an 11 megohm input vacuum tube voltmeter. Voltages may vary as much as 10%.

8. A review of the Circuit Description will prove helpful in indicating where to look for trouble.

NOTE: If the candelabra lamp continuously flashes on and off, check all solder connections, especially on the switches.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the Service and Warranty section of the "Kit Builders Guide", and to the "Factory Repair Service" information on Page 27 of this Manual.

# FACTORY REPAIR SERVICE

You can return your completed kit to the Heath Company Service Department to have it repaired for a minimum service fee. (Kits that have been modified will not be accepted for repair.) If you wish, you can deliver your kit to a nearby Heath Authorized Service Center. These centers are listed in your Heathkit catalog.

To be eligible for replacement parts under the terms of the warranty, equipment returned for factory repair service, or delivered to a Heath Authorized Service Center, must be accompanied by the invoice or the sales slip, or a copy of either. If you send the original invoice or sales slip, it will be returned to you.

If it is not convenient to deliver your kit to a Heath Authorized Service Center, please ship it to the factory at Benton Harbor, Michigan and follow the following shipping instructions:

Prepare a letter in duplicate, containing the following information:

- Your name and return address.
- Date of purchase.
- A brief description of the difficulty.
- The invoice or sales slip, or a copy of either.
- Your authorization to ship the repaired unit back to you C.O.D. for the service and shipping charges, plus the cost of parts not covered by the warranty.

Attach the envelope containing one copy of this letter directly to the unit before packaging, so that we do not overlook this important information. Send the second copy of the letter by separate mail to Heath Company, Attention: Service Department, Benton Harbor, Michigan.

Check the equipment to see that all parts and screws are in place. (Do not include wooden cabinets when shipping receivers, tuners, amplifiers, or TV sets, as these are easily damaged in shipment.) Then, wrap the equipment in heavy paper. Place the equipment in a strong carton, and put at least THREE INCHES of resilient packing material (shredded paper, excelsior, etc.) on all sides, between the equipment and the carton. Seal the carton with gummed paper tape, and tie it with a strong cord. Ship it by prepaid express, United Parcel Service, or insured parcel post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

# SPECIFICATIONS

| | |
|---|---|
| Frequency Range | 10 cps to 100 kc. |
| Frequency Selection | Switch selected, two significant figures and a multiplier. |
| Output Voltage Ranges | Eight ranges, .003 to 10 volts (full scale) with 10 KΩ or higher external load.<br>Six ranges, .003 to 1 volt (full scale) with 600 Ω external load. |
| Output Impedance | 10 volt range, varies between 0 and 1000 Ω.<br>3 volt range, varies between 800 and 1000 Ω.<br>1 volt range and lower, 600 Ω External load and 290 Ω Internal load. |
| db Ranges | -62 db to +22 db; -12 db to +2 db on the meter and -50 db to +20 db on the Output switch in 10 db steps. |
| dbm Ranges (600 Ω External Load) | -62 dbm to +2 dbm; 0 dbm = 1 mw in 600 Ω. |
| Output Indication | Voltage and db scales on meter. |
| Output Meter Accuracy | ±5% of full scale with proper load termination. |
| Frequency Accuracy | Within 5%. |
| Distortion | Less than 0.1% from 20 to 20,000 cps. |
| Tube Complement | 6X4 rectifier.<br>6AU6 voltage amplifier.<br>6CL6 cathode follower. |
| Power Requirements | 105-125 volts, 50/60 cps, 40 watts.<br>210-250 volts, 50/60 cps.<br>Optional wiring instructions included for 220-240 volts operation. |
| Dimensions | 9-1/2" wide x 6-1/2" high x 5" deep. |
| Net Weight | 6 lbs. |

The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

# CIRCUIT DESCRIPTION

The circuitry of the Audio Generator can be divided into four sections: Power Supply, Oscillator, Output Circuit (attenuator), and Meter Circuit. Referring to the Schematic Diagram while reading the Circuit Description may make the operation of the instrument more easily understood.

## POWER SUPPLY

The power supply uses one secondary winding of the power transformer with tube V3 as a full-wave rectifier. The output voltage from rectifier tube V3 is well filtered by capacitors C6A and C6B and the filter choke. This DC voltage is used as a plate supply voltage for tubes V1 and V2.

The other secondary winding of the power transformer supplies the required filament voltage for all three tubes and the pilot lamp.

## OSCILLATOR

The oscillator circuit consists of two tube stages. Tube V1 is connected as a pentode and functions as a broad-band voltage amplifier. Tube V2 is connected as a triode and serves as a cathode follower. Oscillation occurs in this circuit by using positive (regenerative) feedback, from the cathode of tube V2 through the tungsten filament of the 115 V 3-watt lamp, to the cathode of tube V1.

A large negative (degenerative) feedback voltage is coupled from the cathode of tube V2 through what is called a "notch" filter circuit to the grid of tube V1. This negative feedback keeps tube V1 from oscillating at all but the notch frequency. At this one frequency, the negative feedback is at a minimum and phase shift is zero. See Figure 2.

Any tendency on the part of the oscillator circuit to produce signals of varying amplitude is effectively controlled as follows: As the output signal of tube V1 increases, more current is drawn through the voltage divider consisting of the 3-watt lamp and Oscillator control R20. This increased current through the lamp increases the lamp temperature, and thus the lamp resistance increases also. The increased lamp resistance decreases the amount of positive feedback that is coupled to the cathode of tube V1. This decrease in positive feedback reduces the output signal level of tube V1.

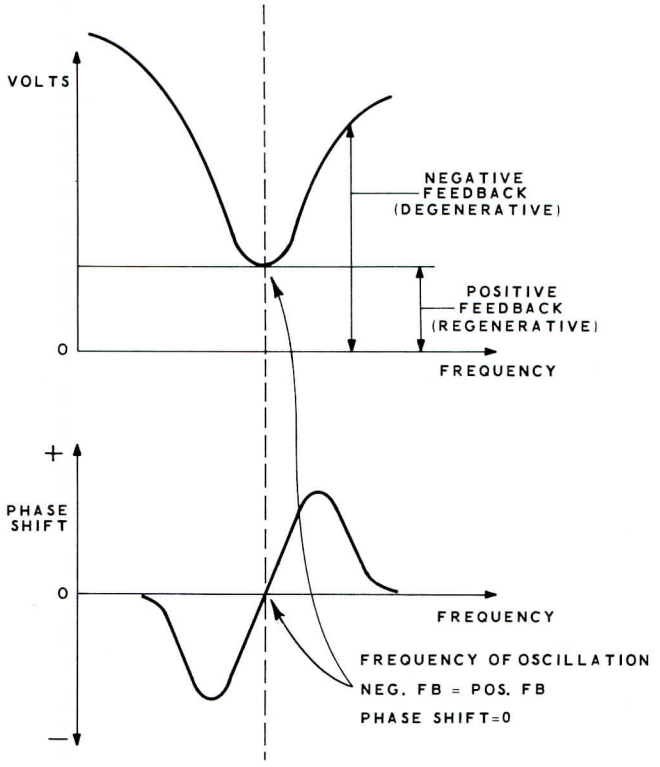



**Figure 2**

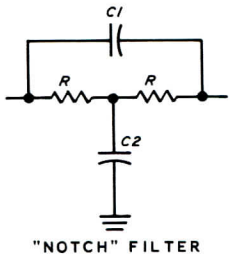
When the oscillator output signal decreases, the lamp cools slightly. This causes the resistance of the lamp to decrease. The lower resistance of the lamp allows more positive feedback to be applied to the cathode of tube V1, thus increasing the output signal of tube V1. In this way, the lamp holds the output of the oscillator constant.

The output of oscillator tube V1 is determined by the setting of Oscillator control R20, which is set for a nominal 10 volt output level.

The notch frequency (oscillator frequency) is determined by the values of resistance and capacitance in the notch filter circuit. These components consist of resistors R1 through R16 on the Cycles switches, and capacitors C1 through C5 on the Multiplier switch (shown in the complete notch filter circuit).

Figure 3 shows the notch filter in simplified form, which consists of two resistors and two capacitors. The values of R, C1, and C2 are shown in Figure 4 for any given switch setting.

Figure 3




"NOTCH" FILTER

The following formula can be used to determine at what frequency the notch will occur for a particular set of resistors and capacitors. In this notch filter, C2 is 10 times larger than C1, and both values of R are the same.

$$\text{Frequency} = \frac{1}{2\pi RC}$$

where $C = \sqrt{C_1 C_2}$

and R = R1 = R2

(R may be only one resistor or several resistors in parallel.)

VALUES OF C

| MULTIPLIER | C1 | C2 |
|---|---|---|
| X1 | .05 | .5 |
| X10 | .005 | .05 |
| X100 | 500 | .005 |
| X1000 | 47 | 500 |

VALUES OF R

| CYCLES | R | CYCLES | R |
|---|---|---|---|
| 10 | 100 K | 1 | 1 MEG |
| 20 | 50 K | 2 | 510 K |
| 30 | 33.3 K | 3 | 330 K |
| 40 | 25 K | 4 | 240 K |
| 50 | 20 K | 5 | 194 K |
| 60 | 16.7 K | 6 | 163 K |
| 70 | 14.3 K | 7 | 139 K |
| 80 | 12.5 K | 8 | 122 K |
| 90 | 11.1 K | 9 | 109 K |
| 100 | 10 K | 10 | 100 K |

Figure 4

With the Multiplier switch in the X1 position and the 0-100 Cycles switch in the 10 position, capacitors C1 and C2 with resistors R3 and R8 form the notch filter circuit. Then the oscillator frequency is 10 cps. To produce a 20 cps signal, these resistances must be halved from 100 KΩ to 50 KΩ since the frequency and resistance are inversely proportional. To increase the frequency to 100 cps (by a factor of 10), the capacitance must be decreased by a factor of 10. At the highest frequencies, the values of the capacitors are slightly below the theoretical value to allow for wiring capacitance.

Frequency variations within a 10 cps span are produced by the 0-10 Cycles switch. Here, the same circuit arrangement is used as in the 0-100 Cycles switch, however the resistance values are 10 times higher. These resistance values are connected in parallel with the resistors on the 0-100 Cycles switch to produce the 1 cps steps.

## OUTPUT CIRCUIT

The output circuit consists of Output control R23, the DB/Volts switch, the 600 Ω Load switch, and resistors R29 through R42. When control R23 is set for maximum output, there is 10 volts of signal applied across the voltage divider network consisting of resistors R29 through R41. When the DB/Volts switch is in the +20/10 position, the full output signal is present at the Output terminals. For each decreasing position of the DB/Volts switch, the signal available at the Output terminals is decreased by 10 db.

The output of the Audio Generator is designed to be fed into an external 600 Ω load on the .003 through 1 volt positions, and into a high impedance external load on the 3 and 10 volt positions. The 600 Ω positions of the DB/Volts switch may be terminated in an internal load by placing the Load switch in the Internal position. This places resistor R42 across the output terminals. The internal load is automatically switched out of the circuit in the two HI Z positions of the DB/Volts switch. Figure 5 shows schematically the attenuation and load switching of the DB/Volts switch. The resistors in use at the various settings of the switch are easily identified.

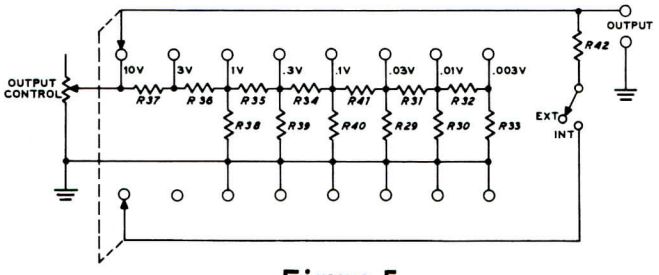
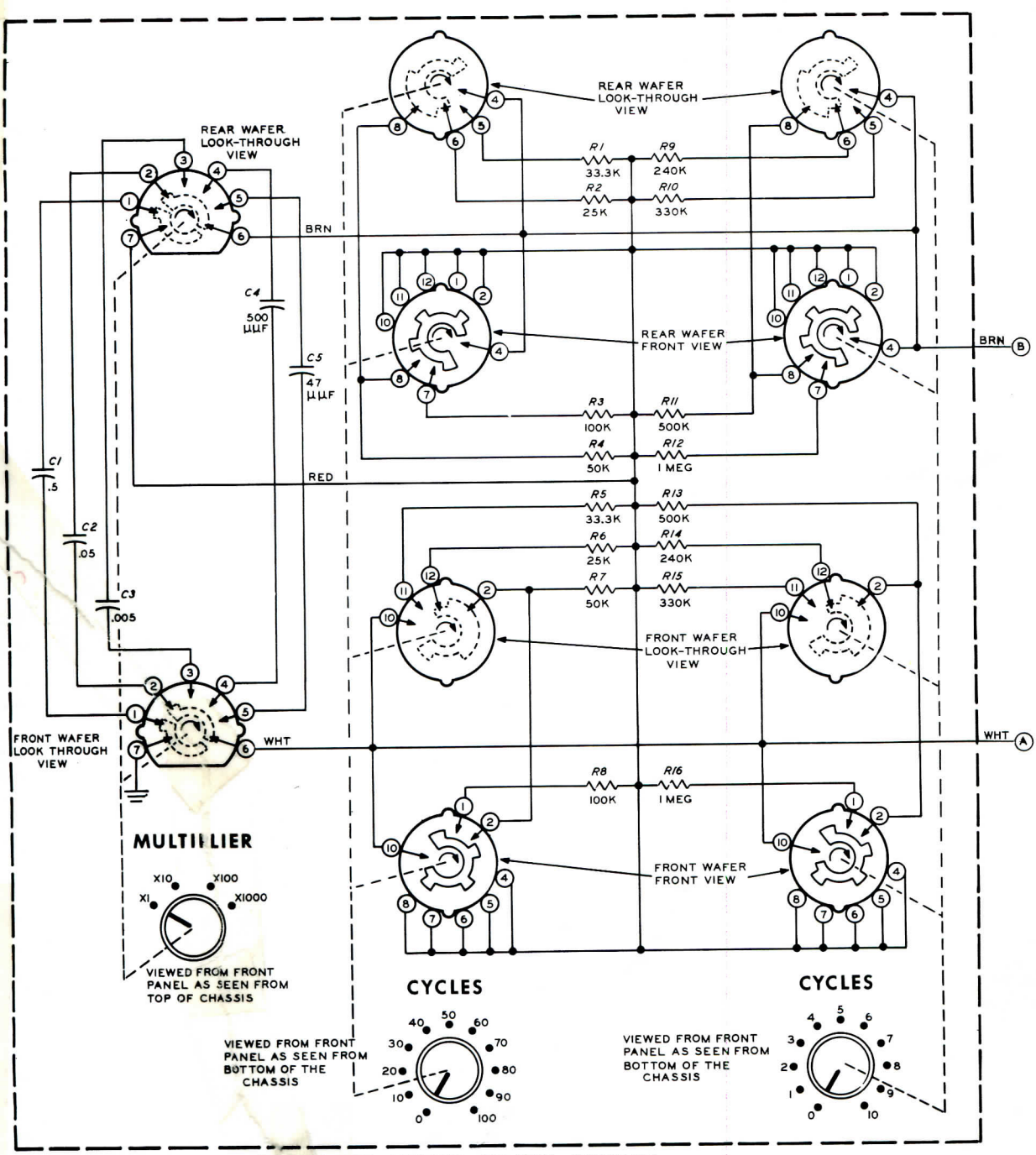


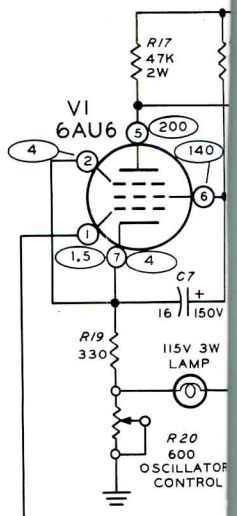

Figure 5

## METER CIRCUIT

The meter circuit measures the voltage at the arm of Output control R23. A portion of this voltage is rectified by the bridge circuit consisting of diodes D1 and D2, and resistors R24 and R25. A third diode, D3, and resistor R26 are added to compensate for diode non-linearity at low signal levels. Meter control R28 is adjusted to give the correct meter indication for the voltage present at the Output terminals.




COMPLETE NOTCH FILTER CIRCUIT




SIMPLIFIED NOTCH FILTER CIRCUIT

NOTES:

ALL RESIS
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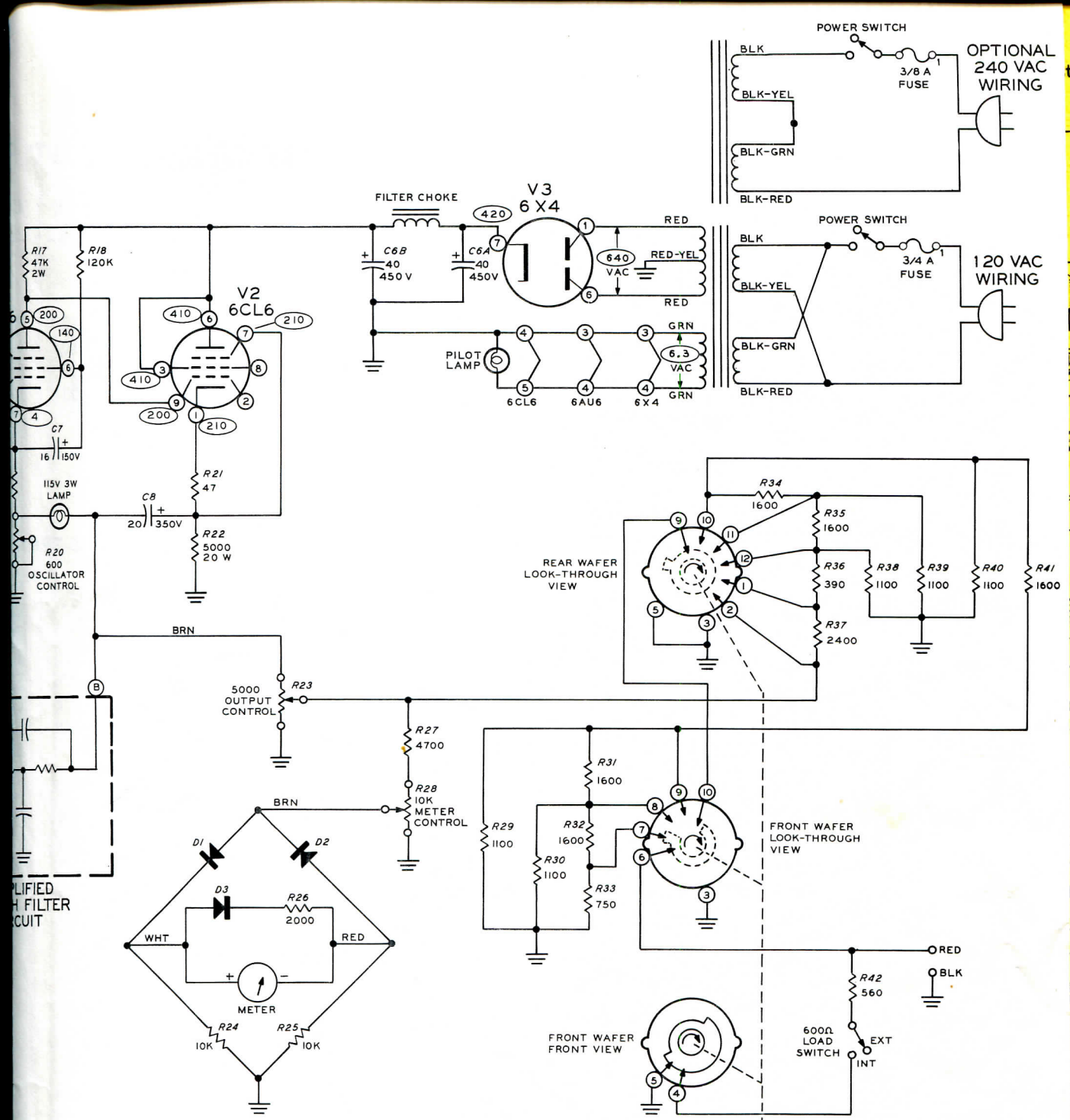


NOTES:

ALL RESISTORS ARE 1/2 WATT UNLESS MARKED OTHERWISE.
ALL RESISTOR VALUES ARE IN OHMS ( K = 1000, MEG = 1,000,000).
ALL CAPACITOR VALUES ARE IN μfd UNLESS MARKED OTHERWISE.
(oval) INDICATES VOLTAGE READING.
ALL VOLTAGES ARE DC POSITIVE UNLESS MARKED OTHERWISE.
ALL VOLTAGES ARE MEASURED FROM POINT INDICATED TO CHASSIS GROUND, EXCEPT AC VOLTAGES ON POWER TRANSFORMER WINDINGS.
VOLTAGE READINGS TAKEN WITH AN 11 MEGOHM INPUT VTVM.
VOLTAGES MAY VARY ±10%.

# SCHEMATIC OF THE HEATHKIT® AUDIO GENERATOR MODEL IG-72

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# REPLACEMENT PARTS PR

To order parts, use the Parts Order Form furnished with this kit. If Parts Order Form is not available, refer to Replacement Parts in the Kit Builders Guide.

| PART No. | PRICE Each | DESCRIPTION |
|---|---|---|
| **RESISTORS** | | |
| **1/2 Watt** | | |
| 1-1 | .10 | 47 Ω |
| 1-4 | .10 | 330 Ω |
| 1-94 | .15 | 390 Ω |
| 1-95 | .15 | 560 Ω |
| 1-96 | .10 | 750 Ω |
| 1-97 | .10 | 1100 Ω |
| 1-98 | .10 | 1600 Ω |
| 1-90 | .10 | 2000 Ω |
| 1-89 | .15 | 2400 Ω |
| 1-16 | .10 | 4700 Ω |
| 1-20 | .10 | 10 KΩ |
| 1-121 | .10 | 120 KΩ |
| 1-99 | .15 | 240 KΩ |
| 1-87 | .10 | 330 KΩ |
| 1-100 | .15 | 510 KΩ |
| 1-101 | .10 | 1 megohm |
| 2-97 | .20 | 25 KΩ 1% |
| 2-98 | .20 | 33.3 KΩ 1% |
| 2-99 | .20 | 50 KΩ 1% |
| 2-11 | .25 | 100 KΩ 1% |
| **2 Watt and 20 Watt** | | |
| 1-10-2 | .20 | 47 KΩ 2 watt |
| 3-2-20 | .80 | 5000 Ω 20 watt |
| **CAPACITORS** | | |
| 20-1 | .15 | 47 μμf mica |
| 20-55 | .20 | 500 μμf mica |
| 23-67 | .65 | .005 μfd tubular |
| 23-68 | 1.10 | .05 μfd tubular |
| 23-69 | 1.75 | .5 μfd tubular |
| 25-5 | .55 | 16 μfd 150 V electrolytic |
| 25-16 | .80 | 20 μfd 350 V electrolytic |
| 25-37 | 1.70 | 40-40 μfd 450 V electrolytic |
| **CONTROLS** | | |
| 10-34 | .60 | 600 Ω |
| 10-7 | .50 | 5000 Ω |
| 10-8 | .50 | 10 KΩ |

| PART No. | PRICE Each | DESCRIPTION |
|---|---|---|
| **SWITCHES** | | |
| 60-1 | .15 | SPST slide |
| 63-8 | 2.10 | 4-position rotary |
| 63-107 | 2.00 | 8-position rotary |
| 63-108 | 2.00 | 11-position rotary |
| **INSULATORS-TERMINAL STRIPS-SO** | | |
| 73-1 | .10 | Rubber grommet |
| 75-17 | .10 | Binding post insula |
| 75-71 | .10 | Strain relief insula |
| 100-16-2 | .10 | Binding post cap (b |
| 100-16-18 | .10 | Binding cap post (r |
| 481-3 | .10 | Capacitor mounting |
| 431-45 | .10 | 6-lug terminal stri mounting foot |
| 431-19 | .15 | 5-lug terminal s mounting feet |
| 431-23 | .25 | Terminal board |
| 434-15 | .10 | 7-pin tube socket |
| 434-16 | .10 | 9-pin tube socket |
| 434-47 | .15 | Pilot lamp socket |
| 434-23 | .25 | Candelabra lamp s |
| **HARDWARE** | | |
| 250-2 | .05 | 3-48 x 5/16" scre |
| 250-8 | .05 | #6 x 3/8" sheet m |
| 250-9 | .05 | 6-32 x 3/8" screw |
| 250-48 | .05 | 6-32 x 1/2" screw |
| 250-83 | .05 | #10 x 1/2" sheet m |
| 252-1 | .05 | 3-48 nut |
| 252-3 | .05 | 6-32 nut |
| 252-7 | .05 | Control nut |
| 253-9 | .05 | #8 flat steel washe |
| 253-10 | .05 | Control flat washe |
| 254-1 | .05 | #6 lockwasher |
| 254-4 | .05 | Control lockwashe |
| 259-1 | .05 | #6 solder lug |
| 259-10 | .05 | Control solder lug |
| 427-3 | .15 | Binding post base |

# PARTS PRICE LIST

DESCRIPTION

SPST slide
4-position rotary
8-position rotary
11-position rotary

MINAL STRIPS-SOCKETS

Rubber grommet
Binding post insulator
Strain relief insulator
Binding post cap (black)
Binding cap post (red)
Capacitor mounting wafer
6-lug terminal strip, one mounting foot
5-lug terminal strip, two mounting feet
Terminal board
7-pin tube socket
9-pin tube socket
Pilot lamp socket
Candelabra lamp socket

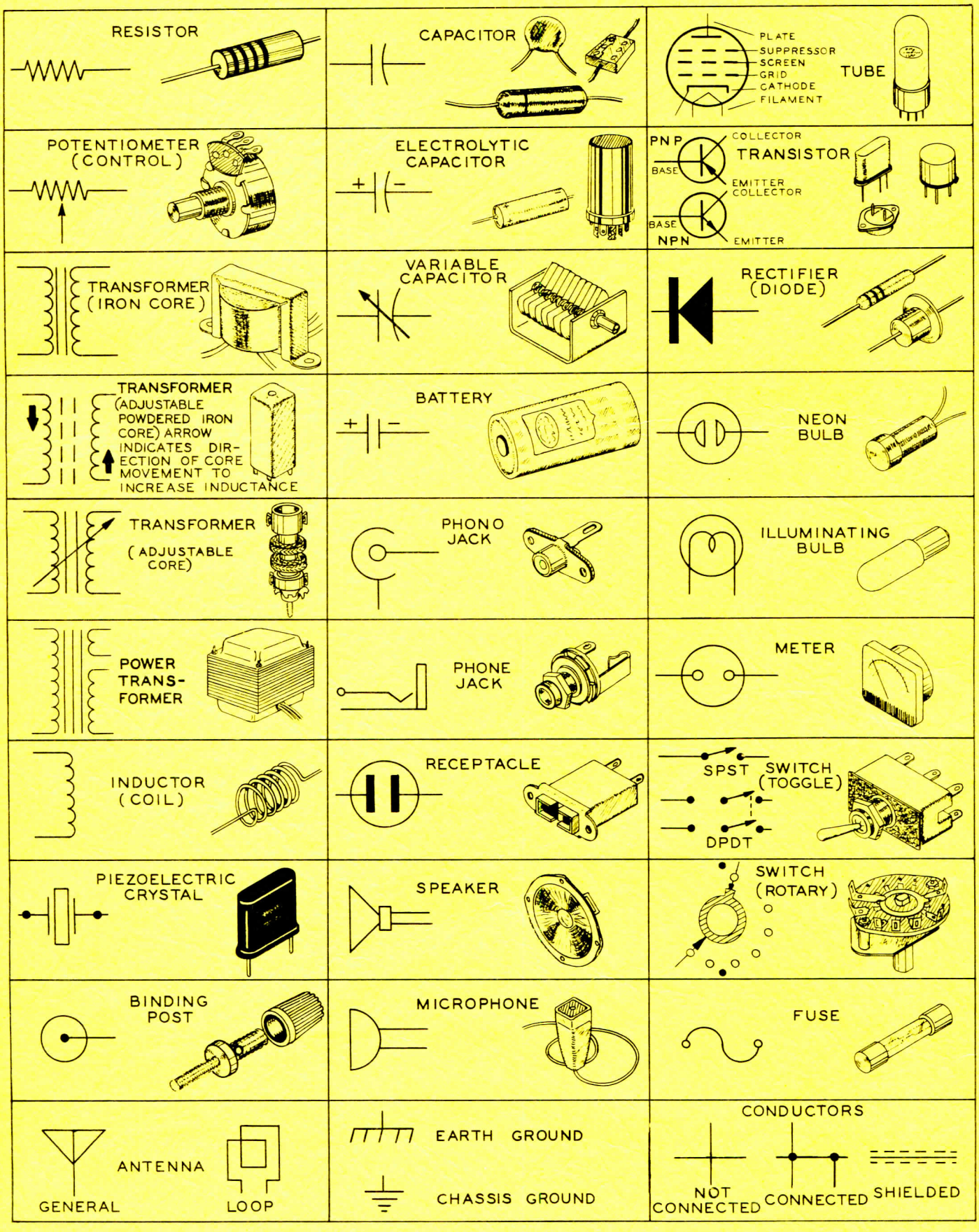
3-48 x 5/16" screw
#6 x 3/8" sheet metal screw
6-32 x 3/8" screw
6-32 x 1/2" screw
#10 x 1/2" sheet metal screw
3-48 nut
6-32 nut
Control nut
#8 flat steel washer
Control flat washer
#6 lockwasher
Control lockwasher
#6 solder lug
Control solder lug
Binding post base

| PART No. | PRICE Each | DESCRIPTION |
|---|---|---|
| **TUBES-LAMPS** | | |
| 411-11 | 1.00 | 6AU6 tube |
| 411-63 | 1.90 | 6CL6 tube |
| 411-64 | .80 | 6X4 tube |
| 412-4 | .15 | #50 pilot lamp |
| 412-2 | .55 | 3 watt candelabra lamp |
| **WIRE-SLEEVING** | | |
| 89-1 | .35 | Line cord |
| 340-2 | .05/ft | Bare wire |
| 344-51 | .05/ft | Brown hookup wire |
| 344-52 | .05/ft | Red hookup wire |
| 344-59 | .05/ft | White hookup wire |
| 346-1 | .05/ft | Small sleeving |
| 346-6 | .05/ft | Large sleeving |
| **METAL PARTS** | | |
| 90-235 | 4.75 | Cabinet |
| 200-580 | 1.00 | Chassis |
| 203-80-3 | 1.20 | Front panel |
| **MISCELLANEOUS** | | |
| 46-3 | 1.45 | Filter choke |
| 54-253 | 5.00 | Power transformer |
| 56-26 | .30 | Crystal diode |
| 211-15 | .20 | Plastic handle |
| 261-9 | .05 | Rubber foot |
| 407-85 | 11.30 | Meter |
| 421-17 | .15 | 3/4 ampere pigtail fuse |
| 462-187 | .30 | Knob |
| 490-5 | .10 | Nut starter |
| 331-6 | .15 | Solder |
| | 2.00 | Manual (See front cover for part number.) |

The above prices apply only on purchases from the Heath Company where shipment is to a U.S.A. destination. Add 10% (minimum 25 cents) to the price when ordering from a Heathkit Electronic Center to cover local sales tax, postage and handling. Outside the U.S.A. parts and service are available from your local Heathkit source and will reflect additional transportation, taxes, duties and rates of exchange.

# TYPICAL COMPONENT TYPES

This chart is a guide to commonly used types of electronic components. The symbols and related illustrations should prove helpful in identifying most parts and reading the schematic diagrams.



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